FOREST PRACTICES
CODE

of

BRITISH COLUMBIA

Establishment to Free Growing Guidebook
Prince Rupert Forest Region

Revised edition
May 2000

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Establishment to Free Growing Guidebook

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Operational Planning Regulation
Strategic Planning Regulation
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Preface

This guidebook has been prepared to help forest resource managers plan, prescribe, and implement sound forest practices that comply with the Forest Practices Code.

Guidebooks are one of the four components of the Forest Practices Code. The others are the ***Forest Practices Code of British Columbia Act***, the regulations, and the standards. The *Forest Practices Code of British Columbia Act* is the legislative umbrella authorizing the Code's other components. It enables the Code, establishes mandatory requirements for planning and forest practices, sets enforcement and penalty provisions, and specifies administrative arrangements. The **regulations** lay out the forest practices that apply province-wide. **Standards** may be established by the chief forester, where required, to expand on a regulation. Both regulations and standards where required and established under the Code, must be followed.

Forest Practices Code guidebooks have been developed to support the regulations, but are not part of the legislation. The recommendations in the guidebooks are not mandatory requirements, but once a recommended practice is included in a plan, prescription, or contract, it becomes legally enforceable. Guidebooks are not intended to provide a legal interpretation of the *Act* or regulations. In general, they describe procedures, practices, and results that are consistent with the legislated requirements of the Code.

The information provided in each guidebook is intended to help users exercise their professional judgement in developing site-specific management strategies and prescriptions designed to accommodate resource management objectives. Some guidebook recommendations provide a range of options or outcomes considered to be acceptable under varying circumstances.

Where ranges are not specified, flexibility in the application of guidebook recommendations may be required to adequately achieve land use and resource management objectives specified in higher level plans. A recommended practice may also be modified when an alternative could provide better results for forest resource stewardship. The examples provided in many guidebooks are not intended to be definitive and should not be interpreted as being the only acceptable options.

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Introduction and purpose

The *Forest Practices Code of British Columbia Act* requires that everyone responsible for silviculture prescriptions ensures that prescriptions include appropriate species selection, stocking, and specified free growing requirements. This guide focuses on the legal requirements for stand establishment, maintenance, and the production of a free growing stand.

Information in the guide is divided into three sections.

The first section includes the main body of the guidebook. This section covers the legislative authority, background, definitions, and procedures for species selection, stocking, establishment, and free growing. For a structured decision process for determining area-specific maximum density values for coniferous trees, refer to the *Guidelines for Developing Stand Density Management Regimes* and the related chief forester's policy. A chart has been included (see Figure 4, page 34) which displays the important dates between the commencement of harvesting and free growing and their relationship to one another. The chart also includes key definitions and a listing of the relevant sections of the Code.

The second section is made up of criteria tables for ecosystem-based forest establishment. These tables contain guidance with respect to information required by the Code for forest establishment and for the determination of free growing, including tree species selection, stocking standards for conifers and broad-leaved trees (i.e., minimum and target stocking standards), regeneration date, earliest and latest free growing assessment dates, minimum tree height, and percent of crop tree over brush height required to meet free growing.

Site- and species-specific tables are provided for coniferous regeneration. The tables list stocking standards for stands where the primary management objective is sawlog production under an even-aged system.

Stocking guidelines for broad-leaved trees have been developed for several management objectives: sawlogs, plywood, pulp, and oriented strand board. Stocking tables for broad-leaved trees, mixedwood stands (where available), and uneven-aged management regimes (single-tree selection) are provided following the even-aged coniferous stocking tables.

The third section consists of appendices with background and support information referred to in the guide. It also includes free growing damage standards.

When selecting tree species and stocking standards for a particular site, be sure to consult all available information, including ecosystem classification guidebooks and relevant *Forest Practices Code* guidebooks.

This guidebook has evolved to incorporate stocking guidelines that address a wider range of management objectives than its original focus on conifer sawlog production under an even-aged system. The organization of the guidebook has not changed significantly, but now provides stocking standards for boreal broadleaves. Other additions include guidelines for integrating grizzly bear habitat and silviculture for coastal ecosystems, and reference to the guidelines for fire-maintained ecosystems in the Kootenay–Boundary Land Use Plan Implementation Strategy. Where another management objective is more important than conifer sawlog production, and where following these guidelines would negatively affect that objective, deviating from the guidelines is recommended. Both species selection and stocking can be done outside of the guidelines if appropriate. This may include fitting into higher level plans or assumptions included in Timber Supply Analyses for TSAs or TFLs, or being consistent with regional manager-approved stand density management regimes as developed through the procedures outlined in the *Guidelines for Developing Stand Density Management Regimes,* or creating a stand structure for a value-added end product, biodiversity, or habitat objectives.

Setting management objectives

Authority:

Forest Practices Code of British Columbia Act

Section 4(3) – Landscape Unit Objectives

Section 12(a)(i) – Silviculture Prescription Content (Long-term Management Objectives)

Operational Planning Regulation

Part 5, Division 2, Section 41 – Species Selection

Strategic Planning Regulation

Part 2, Section 5 – Landscape Unit Objectives for Biological Diversity

Every tree farm licence (TFL) management plan or timber supply area (TSA) plan must have a set of goals or objectives to be achieved in order for the plan to be called successful.

One of the most important decisions made in any reforestation program is how to meet stand objectives over time. This requires a clear understanding of how the stand fits within a management unit and within landscape priorities and how best to meet those priorities. Once a vision of the desired stand has been identified, a set of steps can be formulated to achieve it.

Species selection and the choice of stocking level, combined with prompt and effective establishment, are crucial elements in creating a desired stand.

In British Columbia, most forest sites can support a variety of tree species, allowing the silviculturist a range of species from which to choose. Similarly, the number of trees to be carried on the site at various benchmark times throughout the rotation will determine the size and value of the goods produced from the trees being grown.

This guidebook focuses on the required results at the time of the free growing assessment. It considers the need for flexibility in the prescription and considers integrated resource values that will be generated throughout the rotation.

In selecting the tree species and stocking requirements for each new stand, there are four elements to success:

- identifying desired stand goals throughout the rotation (e.g., stand structure; intermediate product removal)
- identifying ecological site attributes

- knowing and using the inherent silvical characteristics of all species suited to the site
- carefully matching these elements to produce a prescription that meets management objectives.

In British Columbia, forest land is managed for timber, range, recreation, water, fisheries, wildlife, and other purposes. The desired stand structure and tree species composition may not be the same for each of these management strategies, and may have to be adjusted, depending on various management needs.

In this guide, the conifer species selection and stocking tables have been developed for the primary management objective of sawlog production under an even-aged system. The guidelines for broad-leaved trees and mixedwood stands have been developed for various product objectives, including sawlog, plywood, pulp, and oriented strand board production.

Where forest plans specify a particular product objective, integrated resource management goal, or different regeneration assumptions, modification of these guidelines may be required. Conflicts with higher level plans must be resolved at the higher planning level.

Selecting appropriate species

In British Columbia, most forest sites can support a variety of tree species, allowing the silviculturist a range of species from which to choose.

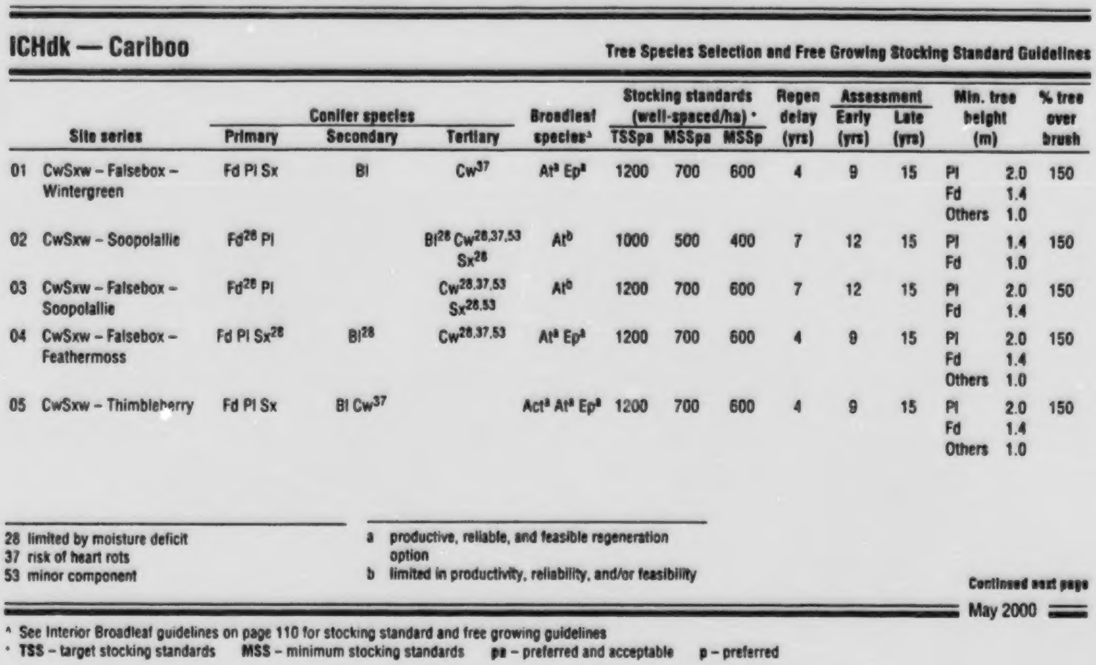
Ecological basis for species selection

The characteristics of tree species, forest sites, and managed forest ecosystems were important considerations in the development of these guidelines. (See Appendix 1 for a synopsis of selected silvical characteristics of major commercial tree species.)

An ecological and ecosystem-specific approach to the selection of tree species and stocking has been adopted. This was necessary because each tree species has adapted to a specific range of environmental conditions, and its growth and behaviour depend on the ecosystem in which it grows. In an unfavourable environment, that species growth potential will not be realized, and its susceptibility to damaging agents will increase.

Correlation by site series

Correlated site series (sites with similar ecological capabilities) provide the ecological framework for this guide. The most recent coding for tree species and for biogeoclimatic zones, subzones, and variants throughout the province is provided in Appendix 2. The relationship between site series and species selection is indicated in Figure 1 and in the tree species selection and stocking tables (page 42).



ICHdk — Cariboo

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species[^]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
01 CwSxw – Falsebox – Wintergreen	Fd Pl Sx	Bl	Cw[37]	At[a] Ep[a]	1200	700	600	4	9	15	Pl Fd Others	2.0 1.4 1.0	150
02 CwSxw – Soopolallie	Fd[28] Pl		Bl[28] Cw[28,37,53] Sx[28]	At[b]	1000	500	400	7	12	15	Pl Fd	1.4 1.0	150
03 CwSxw – Falsebox – Soopolallie	Fd[28] Pl		Cw[28,37,53] Sx[28,53]	At[b]	1200	700	600	7	12	15	Pl Fd	2.0 1.4	150
04 CwSxw – Falsebox – Feathermoss	Fd Pl Sx[28]	Bl[28]	Cw[28,37,53]	At[a] Ep[a]	1200	700	600	4	9	15	Pl Fd Others	2.0 1.4 1.0	150
05 CwSxw – Thimbleberry	Fd Pl Sx	Bl Cw[37]		Act[a] At[a] Ep[a]	1200	700	600	4	9	15	Pl Fd Others	2.0 1.4 1.0	150

28 limited by moisture deficit
37 risk of heart rots
53 minor component

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

May 2000

^ See Interior Broadleaf guidelines on page 110 for stocking standard and free growing guidelines
• TSS – target stocking standards MSS – minimum stocking standards pa – preferred and acceptable p – preferred

Figure 1. Sample table showing potential species and stocking by ecosystem unit.

Preferred and acceptable species

Authority:

Operational Planning Regulation

Part 1, Definitions

Part 5, Division 1, Section 39(1) – Content of Silviculture Prescriptions

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The selection of preferred and acceptable species must be consistent with higher level plans or the forest development plan for the area under the prescription. Preferred and acceptable species are defined below.

Preferred species

Preferred species are ecologically suited to the site. Management activities are primarily aimed at establishing these species. The characteristics of these species are consistent with the desired timber and non-timber objectives for the site.

Acceptable species

Acceptable species are ecologically suited to the site, but management activities are not aimed at establishing them. The reasons for including a species labelled only as acceptable may be a higher-than-acceptable site limitation, such as pest risk, or a lower productivity than the preferred species. Special restrictions or limitations may apply to the use of these species.

Selecting preferred and acceptable species from primary, secondary, and tertiary species

Preferred and acceptable species are generally selected from the list of primary, secondary, and tertiary species provided in the tree species selection and stocking tables (page 42). Figure 1 is an example of one such table. Primary, secondary, and tertiary species were determined on the basis of a species' productivity, reliability, and silvicultural feasibility based on current knowledge of the productive capability of each site series, the silvics of the tree species, and the growth and development of existing second growth forests. For more detailed background information and examples for determining primary, secondary, and tertiary species, see Appendices 3 and 4.

Figure 2 illustrates a systematic process by which preferred and acceptable tree species can be selected. This process should be undertaken before harvest and be reviewed after harvest.

In determining the appropriate preferred and acceptable species, the prescriber is to review the recommended species options for the site. Consider:

- the desired stand structure
- the non-timber objectives for the area
- the desired reproduction method
- the potential for natural regeneration
- the role of advance regeneration
- the hazards, such as pests, likely to affect the stand throughout the rotation (e.g., in areas with a high risk of leader weevil infestation, spruce should be limited to mixed-species stands) (see Appendix 5; refer to the forest health guidebooks for additional information).
- the feasibility of the treatments required to establish the stand under existing management constraints
- the effect of the species or combination of species on the site
- the maintenance of biological diversity.

In general, preferred and acceptable species are selected from the primary and secondary species lists. In some cases, tertiary species also could be preferred or acceptable. In choosing preferred and acceptable species, the prescriber should review the species choices and the species restrictions.

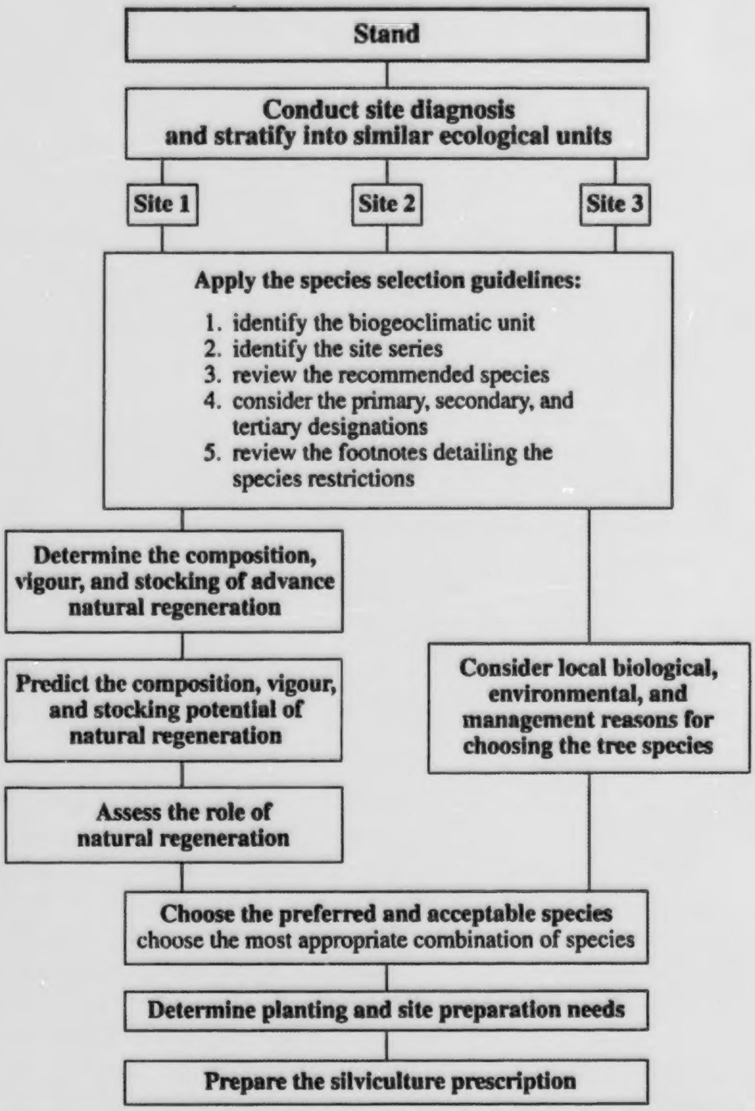

Stand
Conduct site diagnosis and stratify into similar ecological units
Site 1
Site 2
Site 3
Apply the species selection guidelines:
1. identify the biogeoclimatic unit
2. identify the site series
3. review the recommended species
4. consider the primary, secondary, and tertiary designations
5. review the footnotes detailing the species restrictions
Determine the composition, vigour, and stocking of advance natural regeneration
Predict the composition, vigour, and stocking potential of natural regeneration
Assess the role of natural regeneration
Consider local biological, environmental, and management reasons for choosing the tree species
Choose the preferred and acceptable species
choose the most appropriate combination of species
Determine planting and site preparation needs
Prepare the silviculture prescription

Figure 2. Decision making for the site selection of species to regenerate forest sites on a site- and situation-specific basis (modified from Klinka *et al.* 1984).

Primary species

Primary tree species are ecologically acceptable and have a high rating for silvicultural feasibility, reliability, and productivity under the average conditions for a site series. Primary species can be managed as a major component in a stand if the restrictions have been adequately addressed.

Note: **Primary species are not by default the preferred species. Species from any of the three categories can be chosen as preferred, if the species meets the identified management objectives and if restrictions can be dealt with through treatments.**

Secondary species

Secondary species are ecologically acceptable, but rank lower than primary species for one or more of silvicultural feasibility, reliability, or productivity. Depending on the nature and extent of these limitations, secondary species can be managed as either a major or a minor component in a stand.

Tertiary species

Tertiary species are ecologically acceptable, but rank lower than primary or secondary species for one or more of silvicultural feasibility, reliability, or productivity. Depending on the nature of their limitations, on local conditions, and on management objectives, tertiary species are normally suitable only as a minor component within a stand.

For example, tertiary species can be used as a minor component of all stands within an area.

Broadleaf species

Broadleaf species are included as a separate column in the tree species selection and stocking tables due to the unique management considerations associated with broadleaves. This category includes the broadleaf species known to reach tree size within a site series. The footnotes for broadleaves in the stocking tables differentiate when a species is a productive, reliable, and feasible regeneration option versus when it is limited in one or more of these considerations.

Broadleaf species should be used to fulfill silviculture obligations (i.e., preferred or acceptable well-spaced trees) only if they are:

- consistent with TFL or TSA management plans and are deemed acceptable as a new forest crop. The plans should identify those site series appropriate for broadleaf management
- a short-rotation interim crop to manage for root rot centres.

The establishment or retention of broadleaf trees within a stand may be desirable to provide a nurse crop, promote nutrient cycling, or to meet other resource objectives such as biodiversity or wildlife habitat. In recognition of this, the free growing guidelines allow for a broadleaf component, but to a stocking level where the impact on conifer crop tree growth is acceptable.

Where regeneration of broadleaf trees is a product objective, use the broadleaf stocking standards for the coast and interior (after the tree species selection and stocking tables) or the boreal broadleaf stocking guidelines (Appendix 6) as a guide. Changes to these standards are expected where product objectives vary and where the site characteristics cannot support the stems/ha listed in the guide. Maximum density provisions do not apply to areas managed as broadleaf stands or to the broadleaf component in conifer or mixedwood stands.

For additional information, refer to the following publications: *Paper Birch Manager's Handbook for British Columbia, FRDA Report 240; Red Alder Manager's Handbook for British Columbia, FRDA Report 250; Black Cottonwood and Balsam Poplar Manager's Handbook for British Columbia, FRDA Report 230.*

Species restrictions

Restricted species are ecologically acceptable but raise productivity, reliability, or silvicultural feasibility concerns that need to be addressed.

Restricted species may be in primary, secondary, or tertiary categories. Restrictions are denoted by the footnotes in the stocking tables as seen in Figure 1 (see Appendix 7 for interpretations of all restrictions and cautionary notes). Careful attention must be given to the footnotes when selecting species for preferred or acceptable status.

Some restrictions can be accommodated through management activities, allowing particular species to be considered for use as preferred or acceptable.

Restrictions and cautionary notes fall into several categories and are explained in more detail in Appendix 7.

Exotic species

Exotic species are those species that are introduced, accidentally or intentionally, to a region beyond their natural range. The use of exotic species as part of a reforestation strategy must be consistent with the desired timber and non-timber objectives of the site. When contemplating the use of an exotic species, consider the silvics of the species and how it will interact with the characteristics of the intended site series. Exceeding the transfer limits for that species may decrease its productivity or increase its susceptibility to damaging agents. Problems that may arise when species are transferred beyond their ecological tolerance include poor survival or outright mortality, reduced growth, poor stem form, and undesirable wood properties. Exotic species can be used for small operational trials if they are approved in a silviculture prescription. It is recommended that provenance information of the exotic seed source (elevation, latitude, longitude) be submitted with the silviculture prescription. Extended free growing time frames are also recommended to manage the risk associated with the uncertainty of long-term performance of exotic species.

Operational trials should include tagging of sample trees and a commitment to a schedule of assessments.

Incorporation of comments on the performance of exotics should be included in the free growing report.

Seed of exotic species intended for use on Crown land must be registered. In order to be registered, the seed must meet the Ministry of Forests *Technical Standards for Registration.* More information on the use of some exotic species can be found in the *Seed and Vegetative Material Guidebook.*

Mixed species

Authority:

Operational Planning Regulation

Part 5, Division 2, Section 4 – Harvesting Methods

When proposing the species composition for the silviculture prescription, select a mix of species that is ecologically suited to the area if a mix of species was present on the area before the timber was harvested, unless otherwise specified in a higher level plan.

Reasons for promoting a species mix include maintenance of historical species profiles in the landscape, improving stand resilience to damaging agents (e.g., red alder in root rot infected areas), increased future stand value, enhancing biodiversity, biological and ecological benefits, and even cultural considerations (e.g., western redcedar on the Queen Charlotte Islands).

Under appropriate conditions, these objectives can be achieved by establishing mixed-species stands. The choice between establishing a single species or a mixture of species depends on the management objectives, site characteristics, and species compatibility. Factors affecting species compatibility include:

- the rate and level of natural ingress of all species on the specific site
- the relative growth rates of all species on the specific site

- the relative protection requirements and shade tolerance of the species
- the spatial requirements and branching habit of the crowns for the species
- the nutritional effects of the species or combination of species on the soil and each other
- the pathological and biological (morphological) rotation age of each species
- the forest health concerns (contact the local forest health specialists and refer to the various forest health guidebooks).

The integration of these factors determines how a species will perform in pure or mixed-species stands. Irrespective of tree species, a forest stand can be visualized as one of three general structure types:

- even-aged, non-stratified canopy stand structures
- even-aged, stratified canopy stand structures
- uneven-aged, multi-storey stand structures.

A description of these stand structures is included in Appendix 8.

When required to prescribe a mix of species to meet the stocking requirements of the silviculture prescription, it is recommended that generally no more than 80% of the managed stocking be comprised of a single species established either through planting, seeding, or natural reforestation. The determination of an appropriate species mix, however, will be unique to each site and should include consideration, at the landscape level, of what percentage of cutblocks should have a species mix, and the species distribution within each cutblock.

Maximizing diversity on every site may result in stands that are difficult to manage. Therefore, planning for biological diversity is often best done at the landscape level. The desired tree species and stand structure for a specific site should reflect these landscape level objectives.

Several methods may be adopted in order to address landscape level objectives on a site-specific basis. Selecting a single species only for the minimum stocking standard preferred (MSSp) or selecting a minimum stocking standard for a species are both legitimate strategies in the right context. For example, due to heavy deer browse, western redcedar regeneration is a concern on the Queen Charlotte Islands. The high level of browse has led to a serious reduction of redcedar regeneration. On sites where a species mix is required and redcedar was a component of the pre-harvest stand, establishment of a minimum amount of redcedar as part of the reforestation of these sites is generally required.

Forest health

When making the species selection decision, consider forest health concerns for your specific species and site combination. Consult with local forest health specialists for more information.

Soil fertility

When selecting a tree species, consider the effect that tree species, or a combination of tree species, will have on soil fertility. For example, on nutrient-poor sites, successive rotations of western hemlock or white spruce monoculture may result in a decline in productivity by increasing soil acidity. The relative availability of many plant nutrients is reduced by increasing soil acidity. On such sites, the addition of tree species with base-rich litter, such as western redcedar, trembling aspen, or red alder may ameliorate these conditions and improve soil fertility.

Species conversion

Species conversions, where appropriate, can be an effective means of increasing yield and reducing future site-specific hazards (e.g., from diseases, insects, or frosts). However, species conversions should be undertaken only after carefully weighing the relative risks and benefits of the intended plan relative to the silvics of the tree species, the ecology of the site, and biodiversity.

Mixedwood management

Mixedwood management involves managing both broadleaf and coniferous species on the same site. Mixedwood management produces a viable crop of both broadleaf and coniferous trees. Managing broadleaf species may be desirable for a number of reasons, including biodiversity, wildlife habitat, nurse crops for conifers, reducing the risk of forest health problems, and potentially increasing yield. In mixedwood management, broadleaf species often establish at high initial densities and overtop the coniferous component for several decades. For this reason, coniferous species selection in mixedwood stands is often determined by shade tolerance. This may lead to selection of more shade-tolerant secondary and tertiary species as the preferred/acceptable species. Also, the standard definition of free growing may require modification when assessing conifers overtopped by the broadleaf component.

Biodiversity

British Columbia's forests contain a wide variety of ecosystems and species. Land managers should be aware of the need to maintain the biological diversity of these ecosystems in managed second-growth and third-growth forests. Forest trees, while only one component of a forest environment that includes a variety of life processes, are very important in providing structure and habitat for other organisms.

Tree species composition and stand structure are important variables that affect the biological diversity of a forest ecosystem. When planning a new forest, consider the following points.

- Choose species native to the site. Trees provide food, shelter, or substrate for other organisms. Since local tree species have evolved with the local flora and fauna, they are more likely to furnish these needs than are exotic tree species.
- If exotic species are chosen for reforestation, they should be established in mixes with native species.
- Where feasible, establish mixed-species plantations. For example, a slow-growing, shade-tolerant conifer and a fast-growing, shade-intolerant conifer can complement each other. The resulting stand structure can provide both ecological and economic benefits.
- During early stand development, managed forests tend to increase in both species and structural diversity over time. Care must be taken during stand-tending operations so that this natural diversity is not removed inadvertently (e.g., removal of a species from a site during spacing).

Refer to the *Landscape Unit Planning Guide* and to the *Biodiversity Guidebook* for specific details.

Variance for cause

Both tree species composition and the structure of the regenerated stand may have to be modified to achieve non-timber resource objectives (e.g., fisheries, wildlife, range, or recreation). The district manager may allow or require deviations from these guidelines, on a site-specific basis, to meet those objectives.

Selecting appropriate stocking levels

Authority:

Forest Practices Code of British Columbia Act

Section 70 (4) (a)(d)(e) – Silviculture Prescriptions

Operational Planning Regulation

Part 5, Division 1 – Silviculture Prescriptions Scope and Content

Part 5, Division 2 – Silviculture Prescriptions Specific Development Requirements

Initial forest management decisions have a significant impact on the development and nature of a new stand. The choice of stocking standards will influence stand structure, forest biodiversity, stand economics, use by other people, forest health, and rotation lengths. It is crucial that the best decisions be made.

Note: In this guide, stocking standards are referred to frequently. You are cautioned not to confuse this use of the word "standard" with the legislated Standards that make up part of the *Forest Practices Code.*

The references to stocking standards in this guidebook are to provide guidance on maximum density and the number of target and minimum well-spaced stems/ha. In the *Operational Planning Regulation* (*OPR)* the reference to stocking "standards" and "requirements" includes many other factors such as those listed in Section 39 (1).

The conifer stocking guidelines assume the following objectives and considerations:

- sawlogs as the primary product objective
- trade-off between piece size, value, and maximum volume production
- safe pathological rotation age, considering projected pest risks (e.g., Pl 80 years)
- recognition of higher planting costs associated with higher target stocking and increased harvesting and milling costs associated with smaller piece sizes
- minimized need for repeated stand entries
- ability of coastal species to attain full site occupancy at lower densities
- management units with differing approved timber product or other objectives (e.g., IRM or biodiversity) may have different stocking standards, subject to district manager approval.

The guidelines for broadleaf trees have been developed for several management objectives: sawlogs, plywood, pulp, and oriented strand board production.

The stocking guidelines apply to coniferous and broadleaf regeneration in even-aged silvicultural systems, except where indicated. Stocking standards for uneven-aged management (single-tree selection) are located after the even-aged stocking tables.

All sites, except extremely dry and extremely wet ecosystems, were assumed capable of producing similar product objectives at various rotation lengths. Target and minimum stocking guidelines were reduced for extremely dry and wet ecosystems to reflect site-specific carrying capacities (see Figure 1).

Appendix 11 provides guidelines for integrating grizzly bear habitat and silviculture in the coastal western hemlock biogeoclimatic zone.

Modification of the stocking levels in this guidebook may be required in the silviculture prescription, depending on specific site conditions and forest management objectives and silviculture strategies.

Development of stocking standards for a specific management unit (TSA/TFL)

The *Guidelines for Developing Stand Density Management Regimes* and the associated chief forester policy establish a structured decision-making framework to carry out biological, economic, and forest-level analysis to develop density management regimes that will achieve management objectives. This evaluation may result in the identification of minimum and target stocking standards that differ from this guidebook. Where minimum and target stocking standards in approved density management regimes differ from the standards in this guidebook, the approved density management regimes should be the basis for prescribing minimum and target stocking in the silviculture prescription.

For details on process, procedures, and standards in developing density management regimes, refer to the *Guidelines for Developing Stand Density Management Regimes* and chief forester policy.

Manage to target stocking levels

Target stocking level is the number of well-spaced preferred and acceptable trees/ha that will, under normal circumstances, produce an optimum free growing crop. When determining stocking status (i.e., satisfactorily restocked versus not satisfactorily restocked (NSR), free growing versus non-free growing), the target stocking standard sets the maximum number of healthy well-spaced trees used in the calculations of mean number of well-spaced trees and the confidence limits. Unless the district manager approves otherwise, the target stocking standard should be set at the density of trees at the free growing time period which will achieve the target stand conditions at the anticipated harvest age or time period.

Minimum stocking levels

To satisfy basic silviculture requirements, the minimum number of well-spaced trees, both of preferred species and of preferred and acceptable species, must be present at the time of regeneration delay and free growing assessments (Table 1).

For example: In the case where 1200 well-spaced preferred and acceptable trees/ha is the target at free growing, the minimum requirement at the regeneration date and to be maintained through to free growing is 700 well-spaced trees of the preferred and acceptable species, of which there must be a minimum of 600 well-spaced preferred trees/ha in order to classify the site as satisfactorily restocked. The same numbers apply for the site to be declared free growing, with the added condition that the well-spaced trees also meet the free growing criteria.

Table 1. Minimum numbers of preferred and acceptable well-spaced conifers required at regeneration delay and free growing assessments

Target stocking standard at free growing,	**Well-spaced stems/ha**					
preferred and acceptable – TSSpa	**400**	**600**	**800**	**900**	**1000**	**1200**
Minimum stocking standard at regeneration date and to be maintained through to free growing, preferred and acceptable – MSSpa	200	400	400	500	500	700
Minimum stocking standard at regeneration date and to be maintained through to free growing, preferred species only – MSSp	200	400	400	400	400	600

TSS – target stocking standards; MSS – minimum stocking standards; pa – preferred and acceptable; p – preferred

Minimum stocking guidelines represent densities below which yield will be unacceptably lowered, given anticipated final crop densities within planned rotations.

This uniform minimum and target stocking guideline was established for all coniferous species to reflect the current precision of silviculture surveys and operational field survey constraints.

Minimum and target stocking guidelines assume a level of normal or average random mortality beyond free growing. Where local experience or conditions indicate higher levels of random mortality, it is prudent to increase target and minimum stocking levels.

Unless the district manager approves otherwise, minimum stocking standards should be set at a density of trees that considers the entire silviculture regime, including any intermediate interventions, and does not result in unacceptable merchantable volume reductions compared to a stand at the target stocking standard.

The negative impacts on future timber yield must be considered when prescribing and approving stocking standards lower than the recommended minimums as described in these guidelines.

Well-spaced only

The trees used to meet regeneration date and free growing obligations must be well-spaced and of preferred and acceptable species. Both target and minimum stocking guidelines consider well-spaced trees only. The measure of what constitutes a well-spaced tree is the minimum inter-tree spacing (Figure 3). **The minimum inter-tree spacing is to be included in the silviculture prescription.**

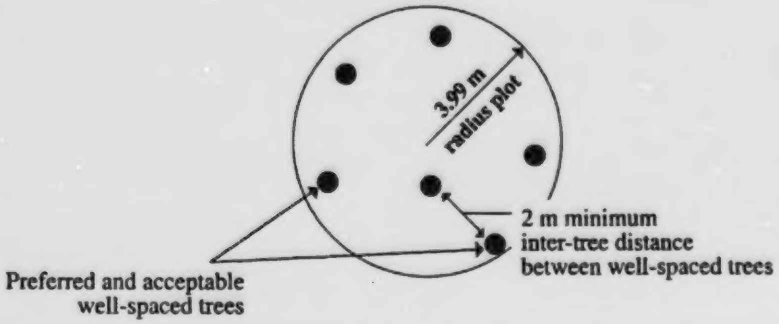


Figure 3. Graphic representation of minimum inter-tree distance and well-spaced trees.

The minimum inter-tree spacing establishes a requirement for a degree of uniformity on tree distribution to ensure good coverage and utilization of growing space. The greater the minimum inter-tree spacing is, the greater the requirement for uniform tree distribution. The decision on minimum inter-tree spacing affects the spacing latitude for site preparation and planting.

The provincial stocking standard guidelines were developed on the assumption of a 2 m minimum inter-tree spacing. While a 2 m minimum inter-tree spacing is suitable for most sites, a reduced inter-tree spacing may be appropriate for sites where plantable spots are limited by site characteristics, a site condition, or where clumpy stem distribution is a normal and desirable stand characteristic.

Examples of situations where a reduced minimum inter-tree spacing may be appropriate include:

- hygric or wetter sites
- very rocky sites
- very harsh sites where protected microsites are critical (e.g., shade, snowcreep)
- areas with a high potential for cattle congregation
- sites with a significant number of large wildlife trees (e.g., 50 uniformly distributed trees/ha)
- riparian areas with a high residual component
- sites where a stump avoidance strategy is employed to manage root rot
- cluster planting (e.g., grizzly bear habitat)
- partial cut areas with an abundance of residual regeneration.

However, the need to address these site-specific factors must be balanced against the effects that reducing the minimum inter-tree spacing has on silviculture survey decisions and the associated yield implications. If prescribing minimum inter-tree distance less than 2 m, consider the following:

1. Volume as predicted by well-spaced density at a 2 m minimum inter-tree spacing is almost independent of tree distribution. As the minimum inter-tree distance is reduced below 2 m, consideration of tree distribution becomes an increasingly important factor in predicting volume production. A minimum inter-tree spacing of less than 2 m increases the Ministry of Forests' risk of accepting stands with reduced volume potential due to gaps in the stand.

   The negative impacts on future yield must be considered when prescribing and approving inter-tree distances lower than the recommended minimums described in these guidelines.

2. Reductions in the minimum allowable horizontal distance below 2 m increases the risk of incorrectly classifying NSR strata as satisfactorily stocked. This risk is further increased by the Ministry of Forests silviculture survey sampling rule: *if initial confidence limits do not enable a decision and extra plots are required, the decision as to whether an area is satisfactorily restocked or free growing is based on the resultant sample mean.* The 2 m minimum allowable horizontal distance is an effective standard to manage this risk.

Once within an approved silviculture prescription, the minimum inter-tree distance will be used to determine the achievement of minimum stocking standards at the regeneration date and during the free growing assessment period. If at any point after silviculture prescription approval the conditions of the site indicate that an alteration to the minimum inter-distance is appropriate, then an amendment to the silviculture prescription would need to be submitted to the district manager for consideration.

Maximum density

To ensure product objectives are met in a timely fashion, maximum density standards have been created for all preferred and acceptable species. Details on the development of management unit specific maximum density limits are provided in the *Guidelines for Developing Stand Density Management Regimes* and the chief forester's policy. In addition to a maximum density limit, the *OPR* requires that the stocking standards include the maximum and minimum number of healthy well-spaced coniferous trees allowed per hectare after a spacing treatment has been carried out.

The *Act* (section 70(4)(f)) states that spacing for maximum density when required must be carried out prior to the end of the free growing period. Where there are forest health, special wildlife habitat, integrated resource management, range, or other objectives or concerns for an area, the range of well-spaced trees resulting from spacing may be varied. Deviations from the acceptable range must be defined in consultation with the district manager when the silviculture prescription is prepared or amended.

The prescribed number of well-spaced trees to be left after spacing normally should not be more than 600 well-spaced trees above the target stocking standard specified in the silviculture prescription. The prescribed minimum number of well-spaced trees to be left after spacing normally should not be lower than the minimum stocking standard in the silviculture prescription. Where you propose maximum and minimum numbers outside these ranges, reasons for the deviation should be documented. For a discussion of the minimum and maximum number of healthy well-spaced trees allowed after spacing, refer to the *Spacing Guidebook*.

Mosaics

In some cases, blocks may contain more than one site series or treatment unit. If objectives or site capability vary between site series or treatment units, different stocking requirements may be necessary and should be provided in the silviculture prescription under different standards units. Where there is a mosaic of different site series within a standards unit that require different stocking levels, it may be appropriate to prescribe the stocking requirements of the dominant treatment unit. However, if the mosaic in a standards unit is comprised of dispersed ecostrata which have distinct characteristics and can be clearly identified, different stocking standards and standards units should be established.

Stocking for backlog sites

Authority:

Forest Practices Code of British Columbia Act

Part 5, Division 1 – Silviculture Prescriptions Scope and Content
1(1) – Definition of a backlog area
23 – Silviculture Prescription – backlog area

On pre-1982 good and medium not sufficiently restocked sites, stands should be considered sufficiently restocked or free growing where the average age of well-spaced, healthy, and vigorous free growing stems is 12 years or older and where the number of well-spaced, healthy, and vigorous **free growing** stems is 60% or more of the minimum stocking standard listed for that species and site in the stocking tables in this guidebook. A volume adjustment must be applied against these sites through to rotation. Values from the volume adjustment factors table for each species and site index must be recorded on the integrated silviculture information system (ISIS) forest cover data.

Variance for cause

This stocking level decision-making process provides an alternative to high cost treatments where the benefits are questionable. This allows funding to be concentrated on higher priority NSR areas. At no time does this decision-making process prevent a manager from treating partially stocked areas to raise them to target stocking levels, providing the benefit outweighs the cost. Additional direction on backlog sites is provided in the Ministry of Forests *Backlog Management Policy*, dated April 30, 1996.

Establishing the stand

Authority:

Forest Practices Code of British Columbia Act

Section 70 (4)(d) – Silviculture Prescriptions

Operational Planning Regulations

Section 39 (3)(o) – Content of Prescriptions

Silviculture Practices Regulations

Section 11 (1) – Reforestation Requirement

Section 23 (b) – Surveys Required

Each site should be evaluated to identify site-specific hazards that will affect the stand throughout the rotation. Generally:

- stands with composition and structure similar to historical stands in any given area may be more resilient and resistant to various local hazards.
- many hazards can be minimized by establishing and maintaining mixed-species stands. Extensive use of single-species stands should be avoided.
- using the appropriate provenance will help maintain stand health. For further information on appropriate provenance, see the *Seed and Vegetative Material Guidebook.*

Regeneration date

Regeneration date means the calendar date (year/month) by which at least the minimum number of healthy well-spaced trees of both the preferred and acceptable species and the minimum preferred species must be established and subsequently maintained until the stand is declared free growing. In these guidelines, short regeneration delay periods (e.g., four years in Figure 1) indicate that planting is the preferred method of reforestation. Longer regeneration delay periods (e.g., seven years in Figure 1) indicate that either planting or natural regeneration may be acceptable methods.

Where both natural regeneration and planting are acceptable options in the silviculture prescription, and natural regeneration is prescribed to augment or provide total stocking, these guidelines recommend that the longer regeneration time frames be used for regeneration delay and free growing. Where planting is prescribed to provide total stocking within a site series where this guide indicates a long regeneration period (i.e., provides for natural regeneration), generally a shorter time frame should be used.

If longer regeneration times are prescribed, an application to advance the timing can be made if goals are achieved ahead of schedule. To achieve this, an amendment must be made to the silviculture prescription free growing assessment period. Prescribed regeneration delays should be consistent, as much as possible, with TSA/TFL regeneration assumptions built into the timber supply review.

The regeneration date and the free growing assessment period are measured from the commencement date, the definition of which is provided in section 70 of the *Forest Practices Code of British Columbia Act* and varies with the silviculture prescription category as indicated in Table 2. A silviculture prescription may have more than one standards unit with differing regeneration dates. In these cases, the stocking requirements must be met by each specific regeneration date on a standards unit basis.

Table 2. Commencement date by silviculture prescription category

Silviculture prescription category	Commencement date*
SP for TSL (non-major), woodlot licence, major licence harvesting	the date when harvesting, excluding road and landing construction, begins on the area under the prescription
Damaged or destroyed timber on TFL or timber licence land	the date of the district manager's approval
Trespass or damaged, destroyed timber on TSA land	the date the district manager gives effect to the prescription
Trespass on woodlot, major licence	the date of the district manager's approval
SP for a backlog area	the date any silviculture treatment under the prescription begins
PHSP prepared or district manager approved and in effect on June 15, 1995	the date when harvesting, excluding road and landing construction, begins on the area under the prescription
SP prepared or district manager approved and in effect on June 15, 1995	the date the district manager prepared or approved the SP

* One commencement date applies to all standard units in a SP.

Evidence of compliance

On or before the regeneration date specified in a prescription, a survey must be carried out to determine whether the number of healthy well-spaced trees/ha exceeds the minimum number set in the prescription. For information about conducting surveys, see the *Silviculture Surveys Guidebook.*

Maintenance of established stand

Stocking in established stands must always be maintained at or above the minimum stocking established for the stand (*Forest Practices Code of British Columbia Act* Section 70(4)(d)).

Requirements of a free growing stand

Authority:

Forest Practices Code of British Columbia Act

Section 1 (1) – Definitions

Section 70 – Silviculture Prescriptions

- Section 70 (4)(e)
- Section 70 (4) (f)
- Section 70 (6) (a), (b)

Minimum time elapsed

The time period between regeneration date and the earliest free growing date for a site series ensures that a minimum amount of time elapses between establishment and free growing (see Figure 1). In combination with the free growing acceptability criteria, this time period ensures that the crop trees reach a stage where they can reasonably be expected to continue development to maturity without significant additional intervention.

For the CWH, CDF, ICH, SBS, SBPS, BWBS, IDF, MS, BG, and PP zones, a minimum of five years should usually elapse before a free growing assessment can be made (i.e., early free growing date equals regeneration delay plus five years). For the ESSF and MH zones, this establishment period is eight years. However, if achievement of minimum heights occurs earlier and neither the potential expression of forest health agents nor the development of competing vegetation is a concern, it may be appropriate to reduce the time period. Additionally, if the regeneration date is achieved earlier than specified in the silviculture prescription, the early free growing date may be advanced by the same amount subject to district manager approval of a silviculture prescription amendment, resulting in a possible earlier fulfilment of basic silvicultural obligations (see Figures 4 and 5 on pages 34 and 35). However, approval would generally be contingent on whether additional time may be required for adequate assessment of forest health agents or competing vegetation (i.e., red alder ingress or canopy expansion).

Stands of some species on certain ecosystems may exhibit slow juvenile growth rates, requiring an extended free growing period before they can be realistically juvenile spaced if maximum density limits are exceeded. Under these circumstances, the earliest and latest free growing dates specified in the silviculture prescription should be adjusted accordingly (see "Maximum density").

Stocking requirements

Stocking requirements are specified in Section 39 of the *Operational Planning Regulation* and vary with different silvicultural systems which, for the purposes of stocking requirements, are grouped as follows:

i) clearcutting, patch cutting, group selection, group shelterwood, group seed tree, retention system, and clearcutting with group reserves

ii) commercial thinning, harvesting of poles, sanitation treatments, and other intermediate cuttings that do not have regeneration objectives

iii) even-aged partial cutting not described in (i)

iv) single tree selection.

For definitions of these silvicultural systems, refer to Table 3 and the definitions section of the *Operational Planning Regulation.*

Table 3. Stocking requirements for each silvicultural system

Categories of silviculture systems	Silviculture prescription content requirements									
Clearcutting, patch cutting, group selection, group shelterwood, group seed tree, retention system, clearcutting with group reserves	preferred/ acceptable	mitd*	target stocking – p&a	minimum stocking – p&a	minimum stocking – p	max. density	max/min post-spacing density	minimum height	height relative to competing vegetation	minimum pruning height	
Commercial thinning, poles, sanitation treatments, other intermediate cuttings that do not have regeneration objectives	preferred/ acceptable	stand structure/ composition goals including planned residual basal area or density	species & function of any trees left standing to satisfy non-timber resource objectives								
Even-aged partial cutting not described in Section 39 (1)(a)	preferred/ acceptable	mitd	target stocking – p&a	minimum stocking – p&a	minimum stocking – p	max. density	max/min post-spacing density	minimum height	height relative to competing vegetation	minimum pruning height	stand structure/ composition goals including planned residual basal area or density
Single tree selection	preferred/ acceptable for all layers	mitd for regen, sapling, pole layers	target stocking – p&a for all layers	minimum stocking – p&a, for all layers	minimum stocking – p for all layers	max. density for the sapling layer	max/min post-spacing density for the sapling layer	minimum height	height relative to competing vegetation	planned residual basal area per ha	approximate number of trees by diameter class

* mitd = minimum inter-tree distance.

Free from brush

The free growing seedling definition was standardized for the CWH, CDF, ICH, SBPS, BWBS, SBS, and the Vancouver Forest Region IDFww. It specified a crop tree to deleterious brush ratio within the 1 m radius cylinder such that the crop tree must have 150% of the height of the competing vegetation. For the ESSF, IDF, MH, MS, PP, and BG zones, the ratio must be 125%.

However, the free growing guidelines (see Appendix 9) refine the assessment of whether a crop tree is impeded by competing vegetation within the 1 m radius of the crop tree trunk. These guidelines provide tolerances for competing vegetation within the required crop tree to deleterious brush ratio. The guidelines can be applied in all zones except the CWH, CDF, and IDFww. The crop tree to deleterious brush ratio will be used to assess all crop trees in the CWH, CDF, and IDFww. It will also be used to identify potentially free growing trees in certain broadleaf communities. Its use in high elevation ecosystems will be limited.

The rationale for the extended early free growing date (eight years rather than five) and lower crop tree to deleterious brush ratio for the ESSF and MH zones is largely based upon slower conifer growth rates and single layer brush communities. By comparison, other zones have more rapid growth rates for both crop trees and competing vegetation, with a more complex, multi-layer brush community, hence the more secure crop tree to deleterious brush ratio of 150%. If a 150% ratio is achieved in the ESSF or MH zones five years after the regeneration date, the district manager can declare the area free growing if the silviculture prescription is amended. Conversely, if it is anticipated that the competing vegetation on-site, or potentially on-site, can overcome the 150% crop tree to deleterious brush ratio after the free growing assessment period, the ratio can be set at a level that will ensure that trees which are declared free growing will remain so. For example, red alder ingress on some sites may create situations where its height within the free growing assessment period will meet the 150% crop tree to deleterious brush ratio, however, the growth of the red alder will overcome, and potentially over-top, the previously declared free growing crop trees. In this situation, an increase in the crop tree to deleterious brush ratio, either for red alder alone or all competing vegetation, may reduce the potential for reversion of the site to a non-free growing state.

A free growing survey will not be completed immediately following brush treatment. The vegetation must be given time to recover before a realistic assessment of free growing can be made. For the ICH, IDF, MS, PP, BG, SBPS, CWH, CDF, MH, and ESSF zones, this period will be a minimum of two complete growing seasons. For the SBS and BWBS zones, this period will be a minimum of two complete growing seasons if brush control was done with herbicides, and three complete growing seasons if the site was manually or otherwise treated. The different periods are based on perceived differences in conifer growth rates and brush re-invasion rates in these zones. There may be exceptions, for example, where a stand is old enough and scheduled for juvenile spacing before any further brushing is to be done.

Healthy

To be declared free growing, trees must be free from damage or infection from insects, disease, mammals, or abiotic agents as outlined in the free growing damage criteria for British Columbia (Appendix 5). Additional information on "Free growing criteria and assessment" is provided in the *Dwarf Mistletoe Management Guidebook*, the *Root Disease Management Guidebook*, and the *Pine Stem Rust Management Guidebook.*

Advance regeneration

Advance regeneration and residual mature and pole layer crop trees, if present, should be carefully evaluated to determine their potential for future management. To produce an acceptable crop, advance regeneration must be of good form, able to grow vigorously when released, be windfirm, and able to produce market-sized trees free of serious defect. When the function of prescribed leave trees in even-aged partial cutting systems includes future timber production, the free growing acceptability criteria should be such that only trees having potential to produce a sound, merchantable tree at rotation are acceptable. Appendix 10 provides free growing acceptability guidelines for advance regeneration and residual mature and pole layer crop trees.

Minimum height requirement

Minimum seedling height complements the seedling/brush ratio by focusing on the seedling as well as the vigour and stature of competing vegetation. The requirement for minimum height at free growing encourages a high standard of silviculture. With total height as a factor, there is a strong incentive to plan and carry out the best silviculture treatment to ensure that the crop is established and growing at an acceptable rate. A minimum height recognizes deleterious factors other than light that may negatively impact the crop tree's rate of growth. For example, salal or pine grass may affect crop performance through underground competition rather than by light interception. Poor microsite selection at time of planting may also affect future crop tree growth rates by limiting the amount of resources available to the seedling. In all these cases, minimum height will reflect the silvicultural strategies employed to overcome these restrictions on growth rate. Early achievement of minimum heights may then result in improved future timber yields.

Many faults or problems that afflict young trees become evident only as the trees reach a certain diameter and height. For example, by the time lodgepole pine reaches a height of 2 m, problems such as terminal weevil, gall rust, pitch moth, and toppling (an effect of root balling or J-planting) will have become evident.

Minimum height is also crucial in identifying snow-related problems, such as breakage of pine at high elevation or increased terminal damage in saplings as they emerge above the prevailing snow cover (e.g., Douglas-fir in the ICH zone of the Cariboo Forest Region or lodgepole pine in the ESSFmv1 zone of the Prince George Forest Region). As the tree grows, roots are exploring the site, and consequently root rots become more evident. In addition, damage from deer decreases after trees reach a minimum height.

The inclusion of minimum height in the legislation has the effect of "leveling the playing field" between species. Without minimum heights, there is a tendency to plant fast-growing species such as pine rather than spruce because of the rapid juvenile growth often experienced by pine. Setting a higher minimum height for species such as pine is justified ecologically and also decreases the incentive to over-use pioneer species. This allows choosing the most ecologically suited species for the site rather than a species to meet an administrative target. Minimum heights were, therefore, set at a point specific to each species and site series beyond which the majority of forest health concerns will have been expressed

Administration

Minimum height guidelines have been set to encourage the establishment of thrifty stands. Deviation from the guidelines is encouraged when it can be justified on specific site-limiting factors or other higher-level considerations. Minimum heights were developed for open grown seedlings. Therefore, when the proposed silvicultural system will result in seedlings developing under shaded conditions that may impact potential height growth, it may be appropriate to adjust the minimum height requirement if no forest health impacts are anticipated. Also, where a single block is made up of a mosaic of different site series with differing minimum heights, the district manager may approve a single minimum height for each species.

Minimum height is required only on silviculture prescriptions approved after June 15, 1995 and on silviculture prescriptions amended to include a minimum height requirement or if the free growing criteria (Appendix 9) are used.

Evidence of compliance

Authority:

Silviculture Practices Regulation

Part 3, Division 5/6

Within the free growing assessment period specified in the prescription, a survey must be carried out to determine whether the area covered by the prescription meets the free growing requirements (SPR s23 (c)). For areas without regeneration objectives, a survey is also required (SPR s26).

See the *Silviculture Surveys Guidebook* for a more detailed definition of free growing and free growing survey procedures. Appendix 5 provides a summary of the pest damage standards to be used in free growing surveys.

Minimum stratum size for not satisfactorily restocked and not free growing areas

An area in which silvicultural systems, stocking standards, and soil conservation standards are uniformly applied is known as a standards unit. Standards units are areas that will be managed to a specified silvicultural system and soil conservation and stocking standard. Standards units must be discreetly surveyed to determine whether or not legal obligations have been met.

Stratum is a general term that means a "division." A standards unit may contain more than one stratum (or forest cover polygon) – for example, a not satisfactorily restocked (NSR) stratum and a sufficiently restocked (SR) stratum. However, when surveying to determine whether stocking standards have been achieved, a stratum must not contain more than one standards unit, unless the stocking standards are the same. Some older pre-harvest silviculture prescriptions are stratified by treatment unit. If **all** of the stocking requirements in the two treatment units are identical, these areas may be surveyed together.

The appropriate time to treat understocked areas is at the regeneration stage, rather than at the free growing stage. Managing towards target stocking at the regeneration date (e.g., by fill planting) and maintaining stocking at or near target stocking levels is the desirable approach. If the silviculture prescription holder believes that further treatments are not feasible, the stocking survey or free growing report must justify the proposed stratification, describe the condition of the NSR or non-free growing area, and explain why further remedial actions are not warranted. This must occur prior to the late free growing date, allowing sufficient time for remedial action to be undertaken if the district manager deems it necessary.

Section 70 of the *Forest Practices Code of British Columbia Act* requires that a free growing stand be established "on those portions of the area under the prescription that are within the net area to be reforested" (NAR). Therefore, the stand must exist on that whole area. However, a degree of discretion must be applied to this provision.

Although a strict interpretation of Section 70 results in the entire area of the silviculture prescription being the relevant area of assessment, meaning that whatever portion of the area is measured must meet the minimum number of well-spaced or free growing stems/ha, discretion must be applied and consideration should be given to the intention of the prescription as a whole and whether or not the actions of the licensee were reasonable in attempting to achieve the required standards. If any area under the prescription has deficiencies, consideration should also be given to the impact, if any, of those deficiencies.

Recommendations

Portions of the NAR that do not meet the prescribed stocking requirements will fall into three categories.

1. The area is too small to be considered a separate stratum. Each opening will have its own unique set of circumstances that will impact the decision of compliance with the prescribed standard.
2. The area is large enough to be considered a separate stratum. However, the stocking requirements in the approved silviculture prescription are inappropriate (e.g., misidentified ecosystem or change in the management objective) and, therefore, a silviculture prescription amendment is necessary. In this case, the stratum is a separate standards unit and the district manager must decide whether to approve the amendment and accept the existing stocking.
3. The area is large enough to be considered a separate stratum, but the area is not a separate standards unit. If a free growing stand that meets the stocking requirements in the approved silviculture prescription can not be established within the specified time frame, this is a potential non-compliance situation.

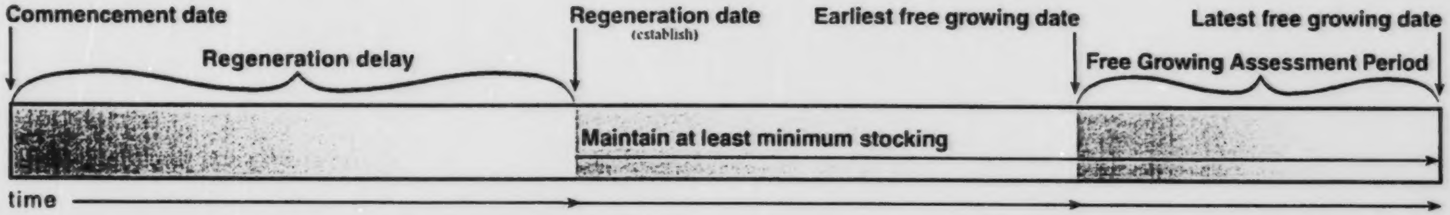
Prior to taking enforcement action, the district manager may wish to consider the following in assessing whether a contravention has occurred:

- management objectives for the block
- productivity of the site
- previous stand characteristics

- configuration of the stratum
- feasibility of treatment
- licensee performance on the entire area under prescription
- standards of the day.

Time frame by which obligations must be met

Responsible forest land management requires that all productive forest land be reforested promptly following disturbance. The *Forest Practices Code of British Columbia Act* stipulates that silviculture prescriptions, required prior to harvest, must include a time frame for establishment of a new stand and for the new stand to be declared free growing. Commencement dates are recorded to the level of month and year in ISIS and subsequent dates are tracked to that level of accuracy. For example, if harvesting commenced January 1997, a three-year regeneration delay would expire at the end of January 2000, and an 11 year latest free growing date would expire at the end of January 2007. The following chart (Figure 4) provides a time line and summary of dates, including associated responsibilities, to be identified in the silviculture prescription.



Commencement date

Forest Practices Code Act, section 70(1)

Commencement date identifies the point in time from which the regeneration date and the free growing assessment period are measured. The commencement date varies by the type of prescription, as outlined in section 70(1).

Regeneration delay

Silviculture Regulation,
B.C. Reg. 147/88 section 1(1)

Regeneration delay is defined in the Forest Act Silviculture Regulation, as it was immediately before its repeal, and applies to prescriptions approved or prepared before April 1, 1994.

Regeneration date

Forest Practices Code Act, sections 70(1), (4)(d)
Operational Planning Regulation
Silviculture Practices Regulation

Regeneration date means the date by which at least the minimum number of healthy well-spaced trees of the preferred and acceptable species per hectare must be established and subsequently maintained until the stand is declared free growing. The regeneration date specified in the silviculture prescription is advanced if goals are achieved ahead of schedule.

On or before the regeneration date specified in a prescription, a survey must be carried out to determine whether the number of healthy well-spaced trees per hectare meets the number set in the prescription. Stocking in established stands must always be maintained at or above the minimum stocking levels established for the stand.

Earliest free growing date

For the ESSF and MH zones, regeneration should be established on-site a minimum of eight years before a free growing assessment can be made. For other biogeoclimatic zones, regeneration should be established on site a minimum of five years before a free growing assessment can be made. If the regeneration is achieved earlier than the regeneration date specified in the silviculture prescription, the district manager may approve a silviculture prescription amendment to advance the early free growing date by the same amount, resulting in a possible earlier fulfilment of basic silviculture obligations.

Free growing assessment period

Forest Practices Code Act, sections 70(1), (4)(e)
Operational Planning Regulation
Silviculture Practices Regulation

The free growing assessment period (FGAP) is the time within which a free growing stand must be established as required in the silviculture prescription. The FGAP is bounded by the earliest and latest free growing dates.

On or before the latest free growing date specified in the silviculture prescription, a survey must be carried out to determine whether the number of healthy well-spaced trees per hectare meets the numbers set in the prescription.

Latest free growing date

Latest free growing date is the latest date specified in a silviculture prescription that a free growing assessment can occur.

If establishment has been retarded (e.g., due to deer browse), the latest free growing date should be amended before the end of the free growing assessment period.

Note that free growing cannot be declared immediately after a brushing treatment, so brushing treatments should be timed to ensure sufficient time to meet free growing criteria prior to the latest free growing date.

Figure 4. Graphic presentation of regeneration time line. Includes definitions and responsibilities for critical points from commencement date to latest free growing date.

Time line

In general, the district manager has the flexibility to accept an area as free growing before the specified early free growing date if all other free growing objectives or criteria have been met. If the licensee submits the free growing report before the early free growing date, the report must be accompanied by a request for an amendment to the silviculture prescription. Such incentives are available to encourage the practice of good silviculture, in return for prompt relief of obligations (Figures 5 and 6).

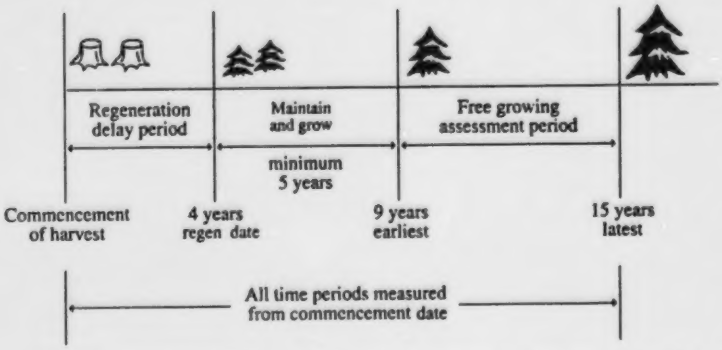


Figure 5. Example of an anticipated time schedule to reach free growing for the Cariboo Forest Region ICHwk2/01 site series.

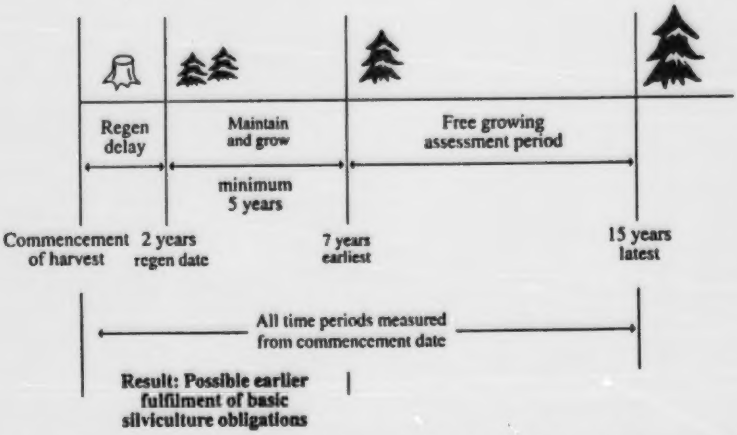

Regen delay
Maintain and grow
Free growing assessment period
minimum 5 years
Commencement of harvest
2 years regen date
7 years earliest
15 years latest
All time periods measured from commencement date
Result: Possible earlier fulfilment of basic silviculture obligations

Figure 6. Another example for the Cariboo Forest Region ICHwk2/01 site series, with prompt silviculture reducing regeneration delay. The earliest free growing assessment date can be reduced from nine to seven years due to prompt reforestation.

Using the guidelines

To select the best combination of species and desired stocking, the following steps are to be taken.

1. Identify the target stand goals, both at and throughout the rotation. This includes end product and integrated resource management objectives. Product objectives may detail desired piece size and volume. IRM objectives may include snag density, the amount of woody debris, and other vegetation or spatial considerations.
2. Identify the ecosystem to the site series level, using field information, biogeoclimatic maps, and regional guidebooks.
3. Consult the appropriate table in these guidelines, or the section in the updated regional guidebook, for the list of crop species suited to the site. Primary, secondary, and tertiary species have been provided to indicate the relative:
    - maximum sustainable productivity
    - crop reliability
    - silvicultural feasibility.

From the list of species suited to the site, determine those that will be managed to create the target stand – **preferred species.**

List also the species that, while not actively managed for, will be considered as acceptable stocking on the site – **acceptable species.**

Note: Species that are not listed as primary, secondary, or tertiary may be used as preferred and acceptable species if appropriate justification can be provided (e.g., biodiversity or IRM objectives). This will be rare for timber product objectives, as the range of commercial species provided in these guidelines is comprehensive.

Following is a representation of the process for evaluation and selection of preferred and acceptable tree species.

- Determine the initial stocking that will create the desired stand. Compare the desired stocking to the minimum and target values provided in the guidelines or guidebook for the site series. If the stated minimums and target levels will achieve the stand objectives, use the guideline stocking levels in the silviculture prescription. In those rare instances where the target and minimum stocking levels provided in the guidelines or guidebook for the site series may not result in the achievement of the stand objectives, variations to the guidelines should be considered. If variations to the guidelines are chosen, justifications for these alternatives should be provided.

These guidelines are to be used in conjunction with regional ecology guidebooks. Ecological guidebooks may have more detailed information regarding species suitability.

For some examples of species selection and the choice of stocking standards, see Appendix 4.

Introduction to tree species selection and stocking tables

Uneven-aged stocking guidelines

Single-tree selection

Minimum inter-tree distance (layers 2, 3, 4): 2 m.

Maximum density (applicable to conifers in layer 3 only): 10 000 stems/ha (sph).

The maximum number of well-spaced stems (sph) following spacing should not normally be greater than 600 above the target stocking set out in the silviculture prescription. For more information on the minimum and maximum number of healthy well-spaced trees allowed after spacing, refer to the *Spacing Guidebook.*

Species: same as in even-aged stocking guidelines.

Crop tree to deleterious brush ratio and minimum height: same as in even-aged stocking guidelines ***except for uneven-aged drybelt Douglas-fir stands within the Interior Douglas-fir zone where trees must be five years on site and at least 40 cm tall.***

Stocking rules

Specific instructions on measurement criteria are in the *Silviculture Surveys Guidebook.*

Stocking for an uneven-aged stand is determined through an additive process. Each layer carries its stocking to contribute to the next. Each tree tallied as a well-spaced, preferred and acceptable tree in the upper layers precludes trees in the lower layers from being tallied. That is, well-spaced trees in layer 2 have to be a minimum of 2 m away from well-spaced trees chosen in layer 1; well-spaced trees in layer 3 have to be a minimum of 2 m away from well-spaced trees in layers 1 and 2; and well-spaced trees in layer 4 have to be a minimum of 2 m away from well-spaced trees in layers 1, 2, and 3.

The stand is considered stocked when the number of well-spaced preferred and acceptable trees and the number of preferred trees:

- in layer 1 are greater than or equal to the minimum stocking for layer 1
- in layers 1 + 2 are greater than or equal to the minimum stocking for layer 2

- in layers 1 + 2 + 3 are greater than or equal to the minimum stocking for layer 3
- in layers 1 + 2 + 3 + 4 are greater than or equal to the minimum stocking for layer 4.

Other silvicultural systems

The use of uneven-aged stocking standards in silviculture prescriptions for systems other than single-tree selection should be thoroughly evaluated to determine the appropriateness of their use. When the decision has been made that uneven-aged stocking standards are appropriate, residuals of unsuitable quality for timber production, retained for other management objectives, should not be used to meet regeneration date and free growing obligations.

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Tree species selection and stocking tables

Prince Rupert Forest Region 43

Broadleaf guidelines 90

Uneven-aged stocking standards (single-tree selection only) 92

Site- and species-specific tables are provided for coniferous and broadleaf regeneration. The tables list target stocking for coniferous stands where the primary management objective is sawlog production under an even-aged system.

Stocking guidelines for broadleaf trees have been developed for several management objectives: sawlogs, plywood, pulp and oriented strand board. Stocking tables for broadleaf trees and uneven-aged management regime (single-tree selection only) are provided following the even-aged coniferous stocking tables.

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BWBSdk1 — Prince Rupert

		Conifer species			Broadleaf	Stocking standards (well-spaced/ha) ⁺			Regen	Assessment		Min. tree		% tree
	Site series	Primary	Secondary	Tertiary	species$^\Delta$	TSSpa	MSSpa	MSSp	delay (yrs)	Early (yrs)	Late (yrs)	height (m)		over brush
01	Sw – Knight's plume – Step moss	Pl Sw^{32}	Bl	Sb	At^b Ep^b	1200	700	600	7	12	15	Pl Others	1.6 0.8	150
02*	Pl – Lingonberry – Feathermoss	Pl		Bl^{50} Sb Sw	At^b	1000	500	400	7	12	15	Pl Others	1.2 0.6	150
03	Sw – Wildrye – Toad-flax	Pl	Sw^{28}		At^b	1200	700	600	7	12	15	Pl Others	1.6 0.8	150
04	Sb – Lingonberry – Knight's plume	Pl		Sb Sw^{32}	At^b	1200	700	600	7	12	15	Pl Others	1.6 0.8	150
05	Sw – Soopolallie – Twinflower	Pl Sw	Bl	Sb	At^a Ep^a	1200	700	600	7	12	15	Pl Others	1.6 0.8	150
06	Sw – Scouring-rush – Step moss	Pl Sw^{32}	Bl	Sb	Acb^b At^b Ep^b	1200	700	600	7	12	15	Pl Others	1.6 0.8	150

* avoid logging
28 limited by moisture deficit
32 limited by growing-season frosts

50 restricted to sites where the species occurs as a major species in a pre-harvest, natural stand

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

$^\Delta$ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

⁺ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

BWBSdk1 — Prince Rupert (continued)

		Conifer species			Broadleaf	Stocking standards (well-spaced/ha)[+]			Regen delay	Assessment		Min. tree height	% tree over
	Site series	Primary	Secondary	Tertiary	species[Δ]	TSSpa	MSSpa	MSSp	(yrs)	Early (yrs)	Late (yrs)	(m)	brush
07	Sb – Lingonberry – Coltsfoot	Pl[1] Sb[1] Sw[1,32]		Bl[50]	At[b]	1200	700	600	7	12	15	Pl 1.6 Others 0.8	150
08	Sw – Currant – Horsetail	Sw[1,32]	Pl[1]	Bl[50] Sb	Acb[a] At[b] Ep[b]	1000	500	400	4	9	15	Pl 1.2 Others 0.6	150
09*	Sb – Horsetail – Sphagnum	Pl[1] Sb[1] Sw[1,32]				400	200	200	4	9	15	Pl 1.2 Others 0.6	150
10*	Sb – Labrador tea – Sphagnum	Pl[1] Sb[1] Sw[1,32]				400	200	200	4	9	15	Pl 1.2 Others 0.6	150
11*	Sw – Willow – Glow moss	Pl[1] Sb[1] Sw[1]			Acb[b] At[b]	400	200	200	4	9	15	Pl 1.2 Others 0.6	150
31	Non-forested bog	non-forested				–	–	–	–	–	–	– –	–
32	Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–
81	Grassland/scrub	non-forested				–	–	–	–	–	–	– –	–

* avoid logging
1 elevated microsites are preferred
32 limited by growing-season frosts

50 restricted to sites where the species occurs as a major species in a pre-harvest, natural stand

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[+] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

BWBSdk2 — Prince Rupert

	Site series	Conifer species			Broadleaf species[△]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
		Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01	Sw – Knight's plume – Step moss	Pl Sw^{32}		Sb	At^{b} Ep^{b}	1200	700	600	7	12	15	Pl 1.6 Others 0.8	150
02*	Pl – Lingonberry – Cladonia	Pl		Sb Sw	At^{b}	1000	500	400	7	12	15	Pl 1.2 Others 0.6	150
03	Sb – Lingonberry – Knight's plume	Pl		Sb Sw^{32}	At^{b}	1200	700	600	7	12	15	Pl 1.6 Others 0.8	150
04	Sb – Labrador tea – Feathermoss	Pl Sb Sw	Lt		At^{b}	1000	500	400	4	9	15	Pl 1.2 Others 0.6	150
05	Sw – Wildrye – Toad-flax	Pl Sw^{32}			At^{a} Ep^{a}	1200	700	600	7	12	15	Pl 1.6 Others 0.8	150
06	Sw – Currant – Horsetail	Sw^{1,32}	Lt^{1} Pl^{1}	Sb	Acb^{a} At^{b} Ep^{b}	1000	500	400	4	9	15	Pl 1.6 Others 0.8	150

* avoid logging
1 elevated microsites are preferred
32 limited by growing-season frosts

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

[△] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

BWBSdk2 — Prince Rupert (continued)

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha)[+]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
07* Sb - Labrador tea – Sphagnum	Lt[1] Pl[1] Sb[1] Sw[1,32]				400	200	200	4	9	15	Pl 1.2 Others 0.6	150
08* Lt – Glow moss	Lt[1] Sb[1] Sw[1,32]				400	200	200	4	9	15	All 0.6	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	– –	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–
81 Grassland/shrub	non-forested				–	–	–	–	–	–	– –	–

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* avoid logging

1 elevated microsites are preferred

32 limited by growing-season frosts

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[+] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvh2 — Prince Rupert

Site series	Conifer species			Broadleaf species[△]	Stocking standards (well-spaced/ha)[+]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 CwHw – Salal	Cw[48] Hw	Pl Yc[48]	Ba[7] Ss[7]	Dr[b]	900	500	400	6	11	14	Hw, Pl 2.0 Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
02* PlYc – Rhacomitrium	Pl	Cw[48] Yc[48]	Hw		400	200	200	3	8	11	Pl 1.4 Others 1.0	150
03 CwYc – Salal	Cw[48] Hw Pl Yc[48]		Ss[7]	Dr[b]	800	400	400	6	11	14	Hw 1.8 Pl 1.4 Others 1.0	150
04 HwSs – Lanky moss	Ba Hw Ss	Cw[48]	Yc[48]	Dr[b]	900	500	400	6	11	14	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
05 CwSs – Sword fern	Ba Cw[48] Ss	Hw[2]	Yc[48]	Dr[b]	900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150

* avoid logging
2 suitable on thick forest floors
7 restricted to nutrient-medium sites

48 risk of heavy browsing by deer
b limited in productivity, reliability, and/or feasibility

Continued next page

[△] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[+] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvh2 — Prince Rupert (continued)

	Site series	Conifer species			Broadleaf	Stocking standards (well-spaced/ha)[•]			Regen	Assessment		Min. tree	% tree
		Primary	Secondary	Tertiary	species[△]	TSSpa	MSSpa	MSSp	delay (yrs)	Early (yrs)	Late (yrs)	height (m)	over brush
06	CwSs – Foamflower	Ba Cw[48] Ss	Hw[2]	Yc[48]	Dr[b]	900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
07	CwSs – Devil's club	Ba Cw[48] Ss	Hw[2]	Yc[48]	Dr[b]	900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
08	Ss – Lily-of-the-valley	Cw[48] Ss	BaHw		Dr[a]	900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
09	Ss – Trisetum	Ss[1]	Ba[1] Cw[1,48]	Hw[1]	Dr[a]	900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
10*	Dr – Lily-of-the-valley	no conifers			Dr[b]	–	–	–	–	–	–	– –	–
11	CwYc – Goldthread	Cw[1,48] Hw[1] Yc[1,48]	Pl[1]			800	400	400	3	8	11	Hw 1.8 Pl 1.4 Others 1.0	150

* avoid logging
1 elevated microsites are preferred
2 suitable on thick forest floors

48 risk of heavy browsing by deer
a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

[△] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvh2 — Prince Rupert (continued)

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species^Δ	Stocking standards (well-spaced/ha) ⁺			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
12* PlYc – Sphagnum	$Cw^{1,48}$ Pl^{1} $Yc^{1,48}$				400	200	200	3	8	11	Pl 1.4 Others 1.0	150
13 CwSs – Skunk cabbage	$Cw^{1,48}$ $Yc^{1,48}$		Ba Hm Hw^{1} Pl Ss^{1}	Dr^{b}	800	400	400	3	8	11	Ss 2.0 Hw 1.8 Others 1.0	150
14* Ss – Salal	Ss		Cw^{48} Hw Pl		400	200	200	3	8	11	Ss 2.0 Hw 1.8 Pl 1.4 Others 1.0	150
15 Ss – Kindbergia	Ss		Cw^{48} Hw		900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5	150
16* Ss – Reedgrass	Ss		Cw^{48} Hw Pl		400	200	200	3	8	11	Ss 2.0 Hw 1.8 Pl 1.4 Others 1.0	150

* avoid logging
1 elevated microsites are preferred

48 risk of heavy browsing by deer
b limited in productivity, reliability, and/or feasibility

Continued next page

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[+] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvh2 — Prince Rupert (continued)

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species^	Stocking standards (well-spaced/ha) ˑ			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
17 Ss – Sword fern	Ss	Cw^{48} Hw	Yc^{48}	Dr^{b}	900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5	150
18* Ss – Slough sedge	$Cw^{1,48}$ Ss^{1}			Dr^{b}	400	200	200	3	8	11	Ss 2.0 Cw 1.0	150
19* Ss – Pacific crab apple	$Cw^{1,48}$ Ss^{1}			Act^{b} Dr^{b}	400	200	200	3	8	11	Ss 2.0 Cw 1.0	150
31 Non-forested topogenous bog	non-forested				–	–	–	–	–	–	– –	–
32 Non-forested slope/blanket bog	non-forested				–	–	–	–	–	–	– –	–
33 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–

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* avoid logging
1 elevated microsites are preferred

48 risk of heavy browsing by deer
b limited in productivity, reliability, and/or feasibility

^ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
ˑ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvm1 — Prince Rupert

Site series	Conifer species			Broadleaf species[▲]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 HwBa – Blueberry	Ba[26] Cw	Hw[30] Ss[7,26,30]		Dr[b]	900	500	400	6	11	14	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
02* HwPl – Cladina	Pl	Cw Fd[22] Hw			400	200	200	3	8	11	Hw, Pl 1.4 Others 1.0	150
03 HwCw – Salal	Cw Hw	Fd[22] Pl		Dr[b]	800	400	400	6	11	14	Hw, Pl 1.4 Others 1.0	150
04 CwHw – Sword fen	Ba Cw	Hw[30] Ss[30,35]		Dr[b]	900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
05 BaCw – Foamflower	Ba Cw	Hw[30] Ss[30,35]		Act[b] Dr[b]	900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150

* avoid logging
7 restricted to nutrient-medium sites
22 restricted to southern Gardner Canal–Kitlope area

26 suitable minor species on salal-dominated sites
30 risk of porcupine damage
35 risk of weevil damage

b limited in productivity, reliability, and/or feasibility

Continued next page

[▲] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvm1 — Prince Rupert (continued)

Site series	Conifer species			Broadleaf species[△]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
06 HwBa – Deer fern	Ba^{26} Cw	Hw^{30} Ss^{7,26,30}	Yc	Dr^{b}	900	500	400	6	11	14	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
07‡ BaCw – Salmonberry	Ba Cw	Hw^{2,30} Ss^{30,35}		Act^{a} Dr^{a}	900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
08 BaSs – Devil's club	Ba Cw	Hw^{2,30} Ss^{30,35}		Act^{a} Dr^{a}	900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
09 Ss – Salmonberry	Ba Cw	Hw^{30} Ss^{30,35}		Act^{a} Dr^{a}	900	500	400	3	8	11	Hw, Ss 2.0 Cw 1.5 Ba 1.4	150
10 Act – Red-osier dogwood		Ba^{1} Cw^{1} Ss^{1,30,35}		Act^{a} Dr^{a}	900	500	400	3	8	11	Ss 2.0 Cw 1.5 Ba 1.4	150

‡ occurs mainly in the Vancouver Region
1 elevated microsites are preferred
2 suitable on thick forest floors
7 restricted to nutrient-medium sites

26 suitable minor species on salal-dominated sites
30 risk of porcupine damage
35 risk of weevil damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

[△] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvm1 — Prince Rupert (continued)

	Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
		Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
11	Act – Willow	no conifers			Act^{b} Dr^{b}	–	–	–	–	–	–	–	–	–
12	CwYc – Goldthread	Cw^{1} Hw^{1,30} Yc^{1}	Pl^{1}	Hm^{1,30}		800	400	400	3	8	11	Hw, Pl Hm Others	1.4 0.8 1.0	150
13*	Pl – Sphagnum	Cw^{1} Pl^{1} Yc^{1}		Hw^{1,30}		400	200	200	3	8	11	Pl, Others	1.4 1.0	150
14	CwSs – Skunk cabbage	Cw^{1}		Ba^{1} Hw^{1,30} Pl^{1} Ss^{1,30} Yc^{1}	Act^{b} Dr^{b}	800	400	400	3	8	11	Hw, Ss Others	1.4 1.0	150
31	Non-forested bog	non-forested				–	–	–	–	–	–	–	–	–
32	Non-forested fen/marsh	non-forested				–	–	–	–	–	–	–	–	–
51	Avalanche track	non-forested				–	–	–	–	–	–	–	–	–

* avoid logging
1 elevated microsites are preferred

30 risk of porcupine damage
b limited in productivity, reliability, and/or feasibility

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvm2 — Prince Rupert

Site series	Conifer species Primary	Conifer species Secondary	Conifer species Tertiary	Broadleaf species▲	Stocking standards (well-spaced/ha)• TSSpa	Stocking standards (well-spaced/ha)• MSSpa	Stocking standards (well-spaced/ha)• MSSp	Regen delay (yrs)	Assessment Early (yrs)	Assessment Late (yrs)	Min. tree height (m)	% tree over brush
01 HwBa – Blueberry	Ba	Cw^{14} Hw^{30} $Ss^{7,30}$ Yc	$Hm^{13,30}$		900	500	400	6	11	14	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
02* HwPl – Cladina	Pl	Cw Hw^{30} Yc	$Hm^{13,30}$		400	200	200	3	8	11	Hw 1.8 Pl 1.4 Others 1.0	150
03 HwCw – Salal	Cw^{14} Hw^{30}	Pl Yc^{13}	$Hm^{13,30}$		800	400	400	6	11	14	Hw 1.8 Pl 1.4 Others 1.0	150
04‡ CwHw – Sword fern	Ba Cw^{14}	Hw^{30} Ss^{30} Yc	$Hm^{13,30}$		900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
05 BaCw – Foamflower	Ba Cw^{14}	Hw^{30} Ss^{30} Yc^{13}	$Hm^{13,30}$		900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150

* avoid logging
‡ occurs mainly in the Vancouver Region
7 restricted to nutrient-medium sites

13 restricted to upper elevations of biogeoclimatic unit
14 restricted to lower elevations of biogeoclimatic unit
30 risk of porcupine damage

Continued next page

▲ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvm2 — Prince Rupert (continued)

Site series	Conifer species			Broadleaf species^Δ	Stocking standards (well-spaced/ha) •			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
06 HwBa – Deer fern	Ba Cw^{14}	Hw^{30} Ss^{7,30} Yc	Hm^{13,30}		900	500	400	6	11	14	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
07‡ BaCw – Salmonberry	Ba Cw^{14}	Hw^{2,30} Ss^{30,35} Yc	Hm^{13,30}		900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
08 BaSs – Devil's club	Ba Cw^{14}	Hw^{2,30} Ss^{30,35} Yc	Hm^{13,30}		900	500	400	3	8	11	Hw, Ss 2.0 Cw, Yc 1.5 Ba 1.4	150
09 CwYc – Goldthread	Cw^{1} Hw^{1,30} Yc^{1}	Hm^{1,30}	Pl^{1}		800	400	400	3	8	11	Hw 1.8 Pl 1.4 Hm 0.8 Others 1.0	150
10* Pl – Sphagnum	Pl^{1} Yc^{1}	Hm^{30}			400	200	200	3	8	11	Pl 1.4 Yc 1.0	150

‡ occurs mainly in Vancouver Region
* avoid logging
1 elevated microsites are preferred
2 suitable on thick forest floors
7 restricted to nutrient-medium sites
13 restricted to upper elevations of biogeoclimatic unit
14 restricted to lower elevations of biogeoclimatic unit
30 risk of porcupine damage
35 risk of weevil damage

Continued next page

Δ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHvm2 — Prince Rupert (continued)

Site series	Conifer species			Broadleaf species▲	Stocking standards (well-spaced/ha)•			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
11 CwYc – Skunk cabbage	Cw[1] Yc[1]		Ba Hm[1,30] Hw[1,30] Ss[1,30]		800	400	400	3	8	11	Hw Ss Others	1.8 1.4 1.0	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	–	–	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	–	–	–
51 Avalanche track	non-forested				–	–	–	–	–	–	–	–	–

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[1] elevated microsites are preferred

[30] risk of porcupine damage

▲ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHwm — Prince Rupert

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species$^{\Delta}$	Stocking standards (well-spaced/ha)$^{+}$			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 HwSs – Blueberry	Hw^{30} Ss^{30}	Ba^{16} Cw^{16} Hm^{12,13,30}	Yc^{12,13}	Dr^{b}	900	500	400	6	11	14	Hw, Ss 2.0 Hm 1.0 Others 1.4	150
02 HwSs – Step moss	Hw^{30} Pl	Cw^{16} Hm^{12,13,30}	Ss^{30}	Dr^{b}	900	500	400	6	11	14	Hw, Pl 2.0 Ss 2.0 Hm 1.0 Others 1.4	150
03 SsHw – Oak fern	Ss^{30}	Ba^{16} Cw^{16} Hw^{30}	Yc^{12,13}	Act^{b} Dr^{b}	900	500	400	3	8	11	Hw, Ss 2.0 Others 1.4	150
04 SsHw – Devil's club	Ss^{30}	Ba^{16} Cw^{16} Hw^{30}	Yc^{12,13}	Act^{b} Dr^{a}	900	500	400	3	8	11	Hw, Ss 2.0 Others 1.4	150
05 Ss – Salmonberry	Ss^{30}	Ba^{16} Cw^{16} Hw^{30}		Act^{a} Dr^{a}	900	500	400	3	8	11	Hw, Ss 2.0 Others 1.4	150

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12 suitable on cold air drainage sites
13 restricted to upper elevations of biogeoclimatic unit
16 restricted to southern portion of biogeoclimatic unit in region
30 risk of porcupine damage
a productive, reliable, and feasible regeneration option
b limited in productivity, reliability and/or feasibility

Continued next page

$^{\Delta}$ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

$^{+}$ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHwm — Prince Rupert (continued)

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species^Δ	Stocking standards (well-spaced/ha) •			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
06 Act – Red-osier dogwood		$Ba^{1,16}$ $Cw^{1,16}$ $Ss^{1,30}$		Act^{a} Dr^{a}	900	500	400	3	8	11	Ss 2.0 Others 1.4	150
07* Act – Willow	no conifers				–	–	–	–	–	–	– –	–
08 Hw – Sphagnum	$Cw^{1,16}$ Pl^{1} Yc^{1}	$Hm^{12,13,30}$ $Hw^{1,30}$		Act^{b} Dr^{b}	900	500	400	6	11	14	Hw, Pl 2.0 Hm 1.0 Others 1.4	150
09 Ss – Skunk cabbage	$Cw^{1,16}$ $Ss^{1,30}$	$Hw^{1,30}$ Yc^{1}	Hm^{30}	Act^{b} Dr^{b}	800	400	400	3	8	11	Hw, Ss 1.4 Others 1.0	150
10* Pl – Sphagnum	$Cw^{1,16}$ Pl^{1} Yc^{1}		Hw^{30}		400	200	200	3	8	11	Pl 1.4 Others 1.0	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	– –	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–
51 Avalanche track	non-forested				–	–	–	–	–	–	– –	–

* avoid logging
1 elevated microsites are preferred
12 suitable on cold air drainage sites
13 restricted to upper elevations of biogeoclimatic unit

16 restricted to southern portion of biogeoclimatic unit in region
30 risk of porcupine damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability and/or feasibility

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^Δ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHws1 — Prince Rupert

Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha) [•]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 HwBa – Bramble	Ba	Cw Hw[30] Pl Sxs[30,35]		Dr[b]	900	500	400	6	11	14	Hw, Pl 2.0 Sxs 2.0 Others 1.4	150
02* Pl – Kinnikinnick	Pl	Hw[30]	Cw		600	400	400	6	11	14	Hw, Pl 1.4 Others 1.0	150
03 HwPl – Feathermoss	Hw Pl	Cw	Ba		900	500	400	6	11	14	Hw, Pl 2.0 Others 1.4	150
04 BaCw – Oak fern	Ba Cw	Hw[2,30] Sxs[30,35]	Pl	Act[b] Dr[b]	900	500	400	3	8	11	Hw, Pl 2.0 Sxs 2.0 Others 1.4	150
05 HwBa – Queen's cup	Ba Cw	Hw[30] Sxs[7,30,35]		Dr[b]	900	500	400	6	11	14	Hw, Sxs 2.0 Others 1.4	150
06 BaCw – Devil's club	Ba Cw	Hw[2,30] Sxs[30,35]		Act[b] Dr[a]	900	500	400	3	8	11	Hw, Sxs 2.0 Others 1.4	150

* avoid logging
2 suitable on thick forest floors
7 restricted to nutrient-medium sites

30 risk of porcupine damage
35 risk of weevil damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability and/or feasibility

Continued next page

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHws1 — Prince Rupert (continued)

Site series	Conifer species			Broadleaf species▵	Stocking standards (well-spaced/ha) •			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
07 Ss – Salmonberry	Ba Cw	Sxs[30,35]	Hw[30]	Act[a] Dr[a]	900	500	400	3	8	11	Hw, Sxs 2.0 Others 1.4	150
08 Act – Red-osier dogwood		Ba[1] Cw[1] Sxs[1,30,35]	Hw[1,30]	Act[a] Dr[a]	900	500	400	3	8	11	Sxs 2.0 Others 1.4	150
09* Act – Willow	no conifers			Act[b] Dr[b]	–	–	–	–	–	–	– –	–
10* Pl – Sphagnum	Pl[1]		Cw[1] Hw[30]		400	200	200	3	8	11	Pl 1.4 Cw 1.0	150
11 CwSs – Skunk cabbage	Cw[1]	Sxs[1,30]	Ba[1] Hw[1,30]	Act[b] Dr[b]	800	400	400	3	8	11	Hw, Sxs 1.4 Others 1.0	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	– –	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–

* avoid logging
1 elevated microsites are preferred

30 risk of porcupine damage
35 risk of weevil damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability and/or feasibility

▵ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHws2 — Prince Rupert

Site series	Conifer species			Broadleaf species$^{\triangle}$	Stocking standards (well-spaced/ha) $^{\bullet}$			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
01 HwBa – Bramble	Ba	Bl^{12} Cw Hw^{30} Pl Sxs^{30}	Hm^{13,30}	Dr^{b}	900	500	400	6	11	14	Pl Hw Others	2.0 1.3 1.0	150
02* Pl – Kinnikinnick	Pl		Cw Hm^{13,30} Hw^{30}		600	400	400	6	11	14	Pl Others	1.4 0.8	150
03 HwPl – Feathermoss	Hw Pl	Cw	Ba Hm^{13,30}	Dr^{b}	900	500	400	6	11	14	Pl Hw Others	2.0 1.3 1.0	150
04 BaCw – Oak fern	Ba	Bl^{12} Cw^{14} Hw^{2,30} Sxs^{30}	Hm^{13,30}	Act^{b} Dr^{b}	900	500	400	3	8	11	Hw Others	1.3 1.0	150
05 HwBa – Queen's cup	Ba	Bl^{12} Cw^{14} Hw^{30} Sxs^{7,30}		Dr^{b}	900	500	400	6	11	14	Hw Others	1.3 1.0	150
06 BaCw – Devil's club	Ba	Bl^{12} Cw^{14} Hw^{2,30} Sxs^{30}		Act^{b} Dr^{b}	900	500	400	3	8	11	Hw Others	1.3 1.0	150

Note	Meaning
*	avoid logging
2	suitable on thick forest floors
7	restricted to nutrient-medium sites
12	suitable on cold air drainage sites
13	restricted to upper elevations of biogeoclimatic unit
14	restricted to lower elevations of biogeoclimatic unit
30	risk of porcupine damage
b	limited in productivity, reliability, and/or feasibility

Continued next page

[△] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

CWHws2 — Prince Rupert (continued)

Site series	Conifer species Primary	Conifer species Secondary	Conifer species Tertiary	Broadleaf species[△]	Stocking standards (well-spaced/ha)[◆] TSSpa	MSSpa	MSSp	Regen delay (yrs)	Assessment Early (yrs)	Assessment Late (yrs)	Min. tree height (m)	% tree over brush
07 Ss – Salmonberry	Ba	Bl[12] Cw Sxs[30]	Hw[30]	Act[a] Dr[a]	900	500	400	3	8	11	Hw 1.3 Others 1.0	150
08 Act – Red-osier dogwood		Ba[1] Bl[12] Cw[1] Sxs[1,30]	Hw[1,30]	Act[a] Dr[a]	900	500	400	3	8	11	All 1.0	150
09 Act – Willow	no conifers			Act[b] Dr[b]	–	–	–	–	–	–	– –	–
10* Pl – Sphagnum	Pl[1]		Cw[1] Hm[30] Hw[30]		400	200	200	3	8	11	Pl 1.4 Others 0.8	150
11 CwSs – Skunk cabbage	Cw[1]	Sxs[1,30]	Ba[1] Hw[1,30]	Act[b] Dr[b]	800	400	400	3	8	11	All 0.8	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	– –	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–
51 Avalanche track	non-forested				–	–	–	–	–	–	– –	–

* avoid logging
1 elevated microsites are preferred

12 suitable on cold air drainage sites
30 risk of porcupine damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

[△] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[◆] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ESSFmc — Prince Rupert

Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha) •			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 Bl – Huckleberry – Leafy liverwort	Bl Se	Pl[34]			1200	700	600	7	15	20	Pl 1.6 Others 0.8	125
02* BlPl – Juniper – Cladonia	Pl	Bl Se			1000	500	400	7	15	20	Pl 1.2 Others 0.6	125
03* Bl – Huckleberry – Crowberry	Pl	Bl Se			1000	500	400	7	15	20	Pl 1.2 Others 0.6	125
04 Bl – Huckleberry – Heron's-bill	Pl	Bl Se			1200	700	600	7	15	20	Pl 1.6 Others 0.8	125
05 Bl – Huckleberry – Thimbleberry	Bl Se	Pl[34]			1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
06 Bl – Oak fern – Heron's bill	Bl Se	Pl[34]			1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
07 Bl – Devil's club – Lady fern	Bl[32] Se[32]		Pl[34]		1200	700	600	4	12	20	Pl 1.6 Others 0.8	125

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* avoid logging
32 limited by growing-season frosts
34 risk of snow damage

Continued next page

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ESSFmc — Prince Rupert (continued)

Site series	Conifer species			Broadleaf	Stocking standards (well-spaced/ha) •			Regen	Assessment		Min. tree height (m)		% tree
	Primary	Secondary	Tertiary	species∆	TSSpa	MSSpa	MSSp	delay (yrs)	Early (yrs)	Late (yrs)			over brush
08* Bl – Valerian – Sickle moss	Bl[32] Se[32]				1000	500	400	4	12	20	All	0.6	125
09 Bl – Horsetail – Glow moss	Bl[1,32] Se[1,32]				1000	500	400	4	12	20	All	0.6	125
10 Bl – Horsetail – Leafy moss	Bl[1,32] Se[1,32]				1000	500	400	4	12	20	All	0.6	125
31 Non-forested wetland	non-forested				–	–	–	–	–	–	–	–	–
51 Avalanche track	non-forested				–	–	–	–	–	–	–	–	–

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* avoid logging

[1] elevated microsites are preferred

[32] limited by growing-season frosts

∆ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ESSFmk — Prince Rupert

Site series	Conifer species			Broadleaf species[▵]	Stocking standards (well-spaced/ha)[+]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 BlHm – Twistedstalk	Bl Se	Hm Pl[34]	Ba[17]		1200	700	600	7	15	20	Pl 1.6 Others 0.8	125
02* BlPa – Cladonia	Pa Pl	Bl Hm Se			1000	500	400	7	15	20	Pl 1.2 Others 0.6	125
03* BlHm – Cladonia	Pa Pl	Bl Hm Se	Ba		1200	700	600	7	15	20	Pl 1.6 Others 0.8	125
04 BlHm – Oak fern	Bl Se	Hm Pl[34]	Ba[17]		1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
05 BlHm – Devil's club – Lady fern	Bl[32] Se[32]	Hm	Ba[17] Pl[34]		1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
06 Bl – Horsetail – Leafy moss	Bl[1,32] Se[1,32]		Ba Hm		1000	500	400	4	12	20	All 0.8	125

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* avoid logging

1 elevated microsites are preferred

17 restricted to western portion of biogeoclimatic unit in region

32 limited by growing-season frosts

34 risk of snow damage

Continued next page

[▵] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[+] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ESSFmk — Prince Rupert (continued)

Tree Species Selection and Free Growing Stocking Standard Guidelines

		Conifer species			Broadleaf	Stocking standards (well-spaced/ha)+			Regen	Assessment		Min. tree		% tree
	Site series	Primary	Secondary	Tertiary	species△	TSSpa	MSSpa	MSSp	delay (yrs)	Early (yrs)	Late (yrs)	height (m)		over brush
07	Bl – Lady fern – Horsetail	Bl[1,32] Se[1,32]		Ba		1000	500	400	4	12	20	All	0.8	125
31	Non-forested bog	non-forested				–	–	–	–	–	–	–	–	–
51	Avalanche track	non-forested				–	–	–	–	–	–	–	–	–

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[1] elevated microsites are preferred
[32] limited by growing-season frosts

△ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
+ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ESSFmv3 — Prince Rupert

Site series	Conifer species			Broadleaf species▵	Stocking standards (well-spaced/ha)⁺			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 Bl – Rhododendron – Feathermoss	Bl Se	Pl[34]			1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
02* BlPl – Crowberry – Cladina	Pl[34]	Bl[28] Se[28]			1000	500	400	4	12	20	Pl 1.2 Others 0.6	125
03 BlSb – Labrador tea	Bl Se	Pl[34]	Sb		1000	500	400	4	12	20	Pl 1.2 Others 0.6	125
04 Bl – Oak fern – Knight's plume	Bl Se		Pl[34]		1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
05 Bl – Devil's club – Rhododendron	Bl Se		Pl[34]		1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
06 Sxw – Huckleberry – Highbush-cranberry	Bl Sx	Pl[34]			1200	700	600	7	12	15	Pl 1.6 Others 0.8	125
07 Bl – Horsetail – Feathermoss	Bl[1,32] Se[1,32]	Pl[1,34]			1000	500	400	4	12	20	Pl 1.2 Others 0.6	125

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* avoid logging

[1] elevated microsites are preferred

[28] limited by moisture deficit

[32] limited by growing-season frosts

[34] risk of snow damage

▵ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

⁺ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ESSFwv — Prince Rupert

Site series	Conifer species			Broadleaf	Stocking standards (well-spaced/ha)[•]			Regen delay	Assessment		Min. tree height	% tree over
	Primary	Secondary	Tertiary	species[▵]	TSSpa	MSSpa	MSSp	(yrs)	Early (yrs)	Late (yrs)	(m)	brush
01 BlHm – Azalea	Bl Se	Pl^{34}	Hm Hw		1200	700	600	7	15	20	Pl 1.6 Others 0.8	125
02* BlPl – Cladonia	Pl	Bl Hm Se			1000	500	400	7	15	20	Pl 1.2 Others 0.6	125
03* BlHm – Feathermoss	Pl	Bl Hm Se	Hw		1200	700	600	7	15	20	Pl 1.6 Others 0.8	125
04 BlHm – Heron's-bill	Pl	Bl Hm Se			1200	700	600	7	15	20	Pl 1.6 Others 0.8	125
05 Bl – Oak fern – Heron's-bill	Bl Se	Pl^{34}	Hm Hw		1200	700	600	4	12	20	Pl 1.6 Others 0.8	125
06 Bl – Devil's club – Lady fern	Bl^{32} Se^{32}		Hm Hw Pl^{34}		1200	700	600	4	12	20	Pl 1.6 Others 0.8	125

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* avoid logging

32 limited by growing-season frosts

34 risk of snow damage

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[▵] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ESSFwv — Prince Rupert (continued)

Site series	Conifer species			Broadleaf species^Δ^	Stocking standards (well-spaced/ha) ⁺			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
07* Bl – Valerian – Sickle moss	Bl^{32} Se^{32}		Hm Hw		1000	500	400	4	12	20	All	0.6	125
08 Bl – Horsetail – Glow moss	Bl^{1,32} Se^{1,32}				1000	500	400	4	12	20	All	0.6	125
09 Bl – Lady fern – Horsetail	Bl^{1,32} Se^{1,32}				1000	500	400	4	12	20	All	0.6	125
31 Non-forested wetland	non-forested				–	–	–	–	–	–	–	–	–
51 Avalanche track	non-forested				–	–	–	–	–	–	–	–	–

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* avoid logging
1 elevated microsites are preferred
32 limited by growing-season frosts

Δ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
⁺ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ICHmc1 — Prince Rupert

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species Primary	Secondary	Tertiary	Broadleaf species[▵]	Stocking standards (well-spaced/ha)[•] TSSpa	MSSpa	MSSp	Regen delay (yrs)	Assessment Early (yrs)	Late (yrs)	Min. tree height (m)	% tree over brush
01 Hw – Step moss	Hw^{32} Pl Sx	Bl^{29}		At^{b} Ep^{b}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
02* Hw – Kinnikinnick – Cladonia	Pl		Bl Hw^{32}	At^{b}	1000	500	400	7	12	15	Pl 1.4 Others 0.8	150
03 HwBl – Oak fern	Hw^{32} Sx^{35}	Bl^{29} Pl		Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
04 HwBl – Devil's club	Sx^{35}	Bl^{29} Hw^{32} Pl		Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
05 ActSx – Dogwood	Sx^{1,35}	Bl^{1,29} Pl^{1}		Act^{a} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
06 Hw – Azalea – Skunk cabbage	Sx^{1}	Bl^{1,29}	Hw^{1,32}	Act^{b}	1000	500	400	4	9	15	All 0.8	150
31 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–

* avoid logging
1 elevated microsites are preferred
29 risk of heavy browsing by moose

32 limited by growing-season frosts
35 risk of weevil damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

[▵] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ICHmc1a — Prince Rupert

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species[▵]	Stocking standards (well-spaced/ha)[◆]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 HwBa – Bramble	Hw[32] Pl Sx	Ba[7]	Bl Cw[23,32]	At[b] Ep[b]	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
02 HwBa – Oak fern	Ba Sx[35]	Hw[32] Pl	Cw[23,32]	Act[b] At[a] Ep[a]	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
03 HwBa – Devil's club – Lady fern	Ba Sx[35]	Hw[32] Pl	Bl Cw[23,32]		1200	700	600	4	9	15	Pl 2.0 Others 1.0	150

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[7] restricted to nutrient-medium sites

[23] restricted to trial use

[32] limited by growing-season frosts

[35] risk of weevil damage

[a] productive, reliable, and feasible regeneration option

[b] limited in productivity, reliability, and/or feasibility

[▵] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[◆] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ICHmc2 — Prince Rupert

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 Hw – Step moss	Hw^{32} Pl Sx	Bl^{29} Cw^{32}		At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
02* Hw – Kinnikinnick – Cladonia	Pl		Bl Hw	At^{b}	1000	500	400	7	12	15	Pl 1.4 Others 0.8	150
03 HwCw – Oak fern	Cw^{32} Hw^{32} Sx^{35}	Bl^{29} Pl	$Ba^{13,17}$	Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
04 CwHw – Devil's club – Oak fern	Cw^{32} Sx^{35}	Bl^{29} Hw^{32} Pl	$Ba^{13,17}$	Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
05 Sx – Devil's club – Lady fern	$Cw^{1,32}$ $Sx^{1,35}$	$Bl^{1,29}$ $Hw^{1,32}$ Pl^{1}	$Ba^{13,17}$	Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
06 ActSx – Dogwood	$Cw^{1,32}$ $Sx^{1,35}$	$Bl^{1,29}$ Pl^{1}	$Hw^{1,32}$	Act^{a} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150

* avoid logging
1 elevated microsites are preferred
13 restricted to upper elevations of biogeoclimatic unit
17 restricted to western portion of biogeoclimatic unit in region

29 risk of heavy browsing by moose
32 limited by growing-season frosts
35 risk of weevil damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ICHmc2 — Prince Rupert (continued)

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species^Δ	Stocking standards (well-spaced/ha) •			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
07 CwSx – Horsetail	Sx^{1}	Bl^{1,29} Cw^{1,32}	Hw^{1,32}, Pl^{1}	Act^{b} At^{b} Ep^{b}	1000	500	400	4	9	15	Pl Others	1.4 1.0	150
08* SbSx – Scrub birch – Sedge	Pl^{1} Sb^{1} Sx^{1,32}				400	200	200	4	9	15	Pl Others	1.4 0.8	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	–	–	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	–	–	–
51 PlHw – Feathermoss	Pl	Bl^{28,29} Sx^{28}	Hw	At^{b} Ep^{b}	1200	700	600	4	9	15	Pl Others	2.0 1.0	150
52 SxEp – Thimbleberry – Hazelnut	Pl Sx	Bl^{29} Cw^{32} Hw^{32}		Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl Others	2.0 1.0	150
53 AtEp – Dogwood	Pl Sx	Bl^{29} Cw^{32} Hw^{32}		Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl Others	2.0 1.0	150
54 SxEp – Devil's club	Cw^{32} Sx	Bl^{29} Hw^{32} Pl	Ba^{13,17}	Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl Others	2.0 1.0	150

* avoid logging
1 elevated microsites are preferred
13 restricted to upper elevations of biogeoclimatic unit
17 restricted to western portion of biogeoclimatic unit in region
28 limited by moisture deficit
29 risk of heavy browsing by moose
32 limited by growing-season frosts
a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasiblity

Δ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ICHvc — Prince Rupert

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species[△]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
01 Hw – Devil's club	Bl	Hw^{32} Sx^{34,35}	Hm	Act^b At^b Ep^b	1200	700	600	4	9	15	All	1.0	150
02 Hw – Step moss	Bl Hw^{32}	Pl^{3,9} Sx^{34}	Hm	At^b Ep^b	1200	700	600	4	9	15	Pl Others	2.0 1.0	150
03 Sx – Devil's club	Bl	Sx^{34,35}	Hw	Act^b At^b Ep^b	1200	700	600	4	9	15	All	1.0	150
04 Sx – Devil's club – Dogwood	Bl^1	Sx^{1,34,35}		Act^a At^b Ep^b	1200	700	600	4	9	15	All	1.0	150
05 ActSx – Dogwood	Bl^1	Sx^{1,32,34,35}		Act^a At^a	1200	700	600	4	9	15	All	1.0	150
06 Sx – Horsetail	Bl^1	Sx^{1,32,34}		Act^b At^b Ep^b	1000	500	400	4	9	15	All	0.8	150
31 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	–	–	–
51* Sitka alder – Devil's club		Bl Sx^{34}			1000	500	400	3	8	11	All	0.8	150
52* Mountain alder – Lady fern			Bl Sx^{34}		400	200	200	3	8	11			150

* avoid logging, generally non-forested units
1 elevated microsites are preferred
3 restricted to coarse-textured soils
9 restricted to southerly aspects

32 limited by growing-season frosts
34 risk of snow damage
35 risk of weevil damage

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability and/or feasibility

[△] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ICHwc — Prince Rupert

Site series	Conifer species			Broadleaf species$^{\triangle}$	Stocking standards (well-spaced/ha) •			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 HwBl – Oak fern	Bl Hw^{32} Sx	Pl		Act^{b} At^{b} Ep^{b}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
02* HwPl – Feathermoss – Cladonia	Pl		Bl Hw	At^{b}	1000	500	400	7	12	15	Pl 1.4 Others 0.8	150
03 Hw – Step moss	Bl Hw^{32} Pl Sx^{28}			At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
04 HwBl – Devil's club	Bl Sx	Hw^{32} Pl		Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
05 Sx – Devil's club	Bl Sx	Hw^{32}	Pl	Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	All 1.0	150
06 ActSx – Dogwood	Bl^{1} Sx^{1}		Hw^{1,32} Pl^{1}	Act^{a} At^{a} Ep^{a}	1200	700	600	4	9	15	All 1.0	150
07 HxSx – Blueberry – Sphagnum	Sx^{1}	Bl^{1} Pl^{1}	Hw^{1,32}		1000	500	400	4	9	15	Pl 1.4 Others 0.8	150

* avoid logging
1 elevated microsites are preferred

28 limited by moisture deficit
32 limited by growing-season frosts

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

△ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

ICHwc — Prince Rupert (continued)

		Conifer species			Broadleaf	Stocking standards (well-spaced/ha)[+]			Regen	Assessment		Min. tree		% tree
	Site series	Primary	Secondary	Tertiary	species[Δ]	TSSpa	MSSpa	MSSp	delay (yrs)	Early (yrs)	Late (yrs)	height (m)		over brush
08	Sx – Horsetail	Bl^1 Sx^1		Hw^{1,32}	Act^b At^b Ep^b	1000	500	400	4	9	15	All	0.8	150
31	Non-forested bog	non-forested				–	–	–	–	–	–	–	–	–
32	Non-forested fen/marsh	non-forested				–	–	–	–	–	–	–	–	–
51	Sitka alder – Devil's club		Bl Sx			1000	500	400	4	9	15	All	0.8	150
52	Mountain alder – Lady fern			Bl^1 Sx^1		400	200	200	3	8	11	All	0.8	150

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1 elevated microsites are preferred
32 limited by growing-season frosts
b limited in productivity, reliability, and/or feasibility

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[+] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

MHmm1 — Prince Rupert

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species$^{\Delta}$	Stocking standards (well-spaced/ha)$^{+}$			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
01 HmBa – Blueberry	Ba Hm Yc		Hw^{14}		900	500	400	7	15	20	All	1.0	125
02* HmBa – Mountain heather	Hm Yc	Ba			800	400	400	4	12	20	All	0.8	125
03 BaHm – Oak fern	Ba Hm Yc		Hw^{14}		900	500	400	4	12	20	All	1.0	125
04 HmBa – Bramble	Ba Hm Yc		Hw^{14}		900	500	400	7	15	20	All	1.0	125
05 BaHm – Twisted stalk	Ba Yc	Hm	Hw^{14}		900	500	400	4	12	20	All	1.0	125
06 HmYc – Deer-cabbage	Hm^{1} Yc1		Ba^{1}		800	400	400	7	15	20	All	0.8	125
07 YcHm – Hellebore	Ba^{1} Yc^{1}	Hm^{1}			900	500	400	4	12	20	All	1.0	125
08* HmYc – Sphagnum	Hm^{1} Yc^{1}		Hw^{1,14}		400	200	200	4	12	20	All	0.8	125
09* YcHm – Skunk cabbage	Yc^{1}	Hm^{1}	Ba^{1} Hw^{1,14}		800	400	400	4	12	20	All	0.8	125
31 Non-forested wetland	non-forested				–	–	–	–	–	–	–	–	–
51 Avalanche track	non-forested				–	–	–	–	–	–	–	–	–

* avoid logging

1 elevated microsites are preferred

14 restricted to lower elevations of biogeoclimatic unit

∆ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

+ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

MHmm2 — Prince Rupert

Site series	Conifer species Primary	Conifer species Secondary	Conifer species Tertiary	Broadleaf species^Δ^	Stocking standards (well-spaced/ha) ⁺ TSSpa	MSSpa	MSSp	Regen delay (yrs)	Assessment Early (yrs)	Assessment Late (yrs)	Min. tree height (m)		% tree over brush
01 HmBa – Blueberry	Ba Hm	Yc^{17}	Bl^{45} $Hw^{14,44}$		900	500	400	7	15	20	All	1.0	125
02* HmBa – Mountain heather	Hm	Ba Yc^{17}	Bl^{45} $Hw^{14,44}$		800	400	400	4	12	20	All	0.8	125
03 BaHm – Oak fern	Ba Hm	Yc^{17}	Bl^{45} $Hw^{14,44}$		900	500	400	4	12	20	All	1.0	125
04 HmBa – Bramble	Ba Hm	Yc^{17}	Bl^{45} $Hw^{14,44}$		900	500	400	7	15	20	All	1.0	125
05 BaHm – Twisted stalk	Ba	Hm Yc^{17}	Bl^{45} $Hw^{14,44}$		900	500	400	4	12	20	All	1.0	125
06 HmYc – Deer-cabbage	Hm^{1}	Yc^{17}	Ba^{1}		800	400	400	7	15	20	All	1.0	125
07 YcHm – Hellebore	Ba^{1}	Hm^{1} $Yc^{1,17}$	$Hw^{1,14,44}$		900	500	400	4	12	20	All	1.0	125
08* HmYc – Sphagnum	Hm^{1}	$Yc^{1,17}$	Ba^{1} Bl^{1} $Hw^{1,14}$		400	200	200	4	12	20	All	0.8	125
09* YcHm – Skunk cabbage	Hm^{1}	$Yc^{1,17}$	Ba^{1} $Hw^{1,14}$		800	400	400	4	12	20	All	0.8	125
31 Non-forested wetland	non-forested				–	–	–	–	–	–	–	–	–
51 Avalanche track	non-forested				–	–	–	–	–	–	–	–	–

* avoid logging
1 elevated microsites are preferred
14 restricted to lower elevations of biogeoclimatic unit
17 restricted to western portion of biogeoclimatic unit in region
44 suitable in areas with stronger maritime influence
45 suitable in areas with stronger continental influence

Δ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

⁺ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

MHwh1 — Prince Rupert

Site series	Conifer species			Broadleaf species$^{\Delta}$	Stocking standards (well-spaced/ha) $^{\bullet}$			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
01 HmSs – Blueberry	Ba Hm Yc	Cw^{14} Hw^{14} Ss^{14}			900	500	400	7	15	20	All	1.0	125
02* HmYc – Mountain heather	Hm Yc	Cw^{14}	Ba		400	200	200	4	12	20	All	0.8	125
03 SsHm – Reedgrass	Hm Yc	Cw^{14} Ss^{14}	Hw^{14}		900	500	400	7	15	20	All	1.0	125
04 HmYc – Goldthread	Hm Yc	Ba Cw^{14} Hw^{14}			900	500	400	7	15	20	All	1.0	125
05 YcHm – Twistedstalk	Ba Yc	Cw^{14} Hm Hw^{14} Ss^{14}	Pl		900	500	400	4	12	20	All	1.0	125
06 HmYc – Deer-cabbage	Hm^{1} Yc^{1}		Ba^{1} Hw^{1,14} Ss^{1,14}		800	400	400	7	15	20	All	0.8	125
07 YcHm – Hellebore	Ba^{1} Yc^{1}	Cw^{14} Hm^{1} Ss^{14}	Hw^{1,14}		900	500	400	4	12	20	All	1.0	125
08* HmYc – Sphagnum	Hm^{1} Yc^{1}		Ba^{1} Hw^{1,14}		400	200	200	4	12	20	All	0.8	125
09* YcHm – Skunk cabbage	Yc^{1}	Cw^{1,14}	Ba Hm^{1} Hw^{1,14} Ss^{1,14}		800	500	400	4	12	20	All	0.8	125
31 Non-forested wetland	non-forested				–	–	–	–	–	–	–	–	–

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* avoid logging

1 elevated microsites are preferred

14 restricted to lower elevations of biogeoclimatic unit

$^{\Delta}$ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

$^{\bullet}$ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBPSmc — Prince Rupert

Site series	Conifer species			Broadleaf species$^{\Delta}$	Stocking standards (well-spaced/ha)$^{\circ}$			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 Pl – Feathermoss – Cladina	Pl		Sb Sx	At^b	1200	700	600	7	12	15	Pl 1.6 Others 0.8	150
02* Pl – Kinnikinnick – Cladonia	Pl		Sb Sx	At^b	1000	500	400	7	12	15	Pl 1.2 Others 0.6	150
03 SbPl – Feathermoss	Pl		Sb Sx	At^b	1200	700	600	7	12	15	Pl 1.6 Others 0.8	150
04 Sxw – Scrub birch – Feathermoss	Pl Sb Sx^{32}			At^b	1000	500	400	4	9	15	Pl 1.2 Others 0.6	150
05 Sxw – Horsetail	Sx^{1,32}	Pl^1	Sb	Act^b	1000	500	400	4	9	15	Pl 1.2 Others 0.6	150
06 Sxw – Horsetail – Glow moss	Sx^{1,32}	Pl^1	Sb	Act^b	1000	500	400	4	9	15	Pl 1.2 Others 0.6	150

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* avoid logging
1 elevated microsites are preferred
32 limited by growing-season frosts

b limited in productivity, reliability, and/or feasibility

Continued next page

$^{\Delta}$ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

$^{\circ}$ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBPSmc — Prince Rupert (continued)

	Conifer species			Broadleaf species△	Stocking standards (well-spaced/ha) ◆			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
Site series	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
07* SbSxw – Scrub birch – Sedge	Pl^{1} Sb^{1} Sx^{1,32}				400	200	200	4	9	15	Pl 1.2 Others 0.6	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	– –	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–

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* avoid logging

1 elevated microsites are preferred

32 limited by growing-season frosts

△ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

◆ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBSdk — Prince Rupert

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species▲	Stocking standards (well-spaced/ha)•			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
01 Sxw – Spirea – Purple peavine	Pl Sx	Fd[9,18]		At[a] Ep[a]	1200	700	600	7	12	15	Pl Fd Others	2.0 1.4 1.0	150
02* Pl – Juniper – Ricegrass	Pl	Sx[28]		At[b] Ep[b]	1000	500	400	7	12	15	Pl Others	1.4 0.8	150
03* Pl – Feathermoss – Cladina	Pl	Sb[28] Sx[28]		At[b]	1200	700	600	7	12	15	Pl Others	2.0 1.0	150
04 Fd – Soopolallie – Feathermoss	Fd Pl	Sx[28]		At[b] Ep[a]	1200	700	600	7	12	15	Pl Fd Others	2.0 1.4 1.0	150
05 Sxw – Spirea – Feathermoss	Pl Sx[28]	Fd[9,18]		At[a] Ep[a]	1200	700	600	7	12	15	Pl Fd Others	2.0 1.4 1.0	150

* avoid logging
9 restricted to southerly aspects
18 restricted to eastern portion of biogeoclimatic unit in region

28 limited by moisture deficit
a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

▲ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBSdk — Prince Rupert (continued)

Site series	Conifer species Primary	Conifer species Secondary	Conifer species Tertiary	Broadleaf species[Δ]	Stocking standards (well-spaced/ha)[+] TSSpa	MSSpa	MSSp	Regen delay (yrs)	Assessment Early (yrs)	Assessment Late (yrs)	Min. tree height (m)	% tree over brush
06 Sxw – Twinberry – Coltsfoot	Pl Sx		Fd[9,18]	Act[a] At[a] Ep[a]	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
07 Sxw – Horsetail	Sx[1,32]	Pl[1]		Act[b] At[b] Ep[b]	1000	500	400	4	9	15	Pl 1.4 Others 0.8	150
08 Act – Dogwood – Prickly rose	Sx[1,32]	Pl[1]		Act[a] At[a] Ep[a]	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
09* Sb – Creeping-snowberry – Sphagnum	Pl[1] Sb[1]		Sx[1]		400	200	200	4	9	15	Pl 1.4 Others 0.8	150
10* Sb – Soft-leaved sedge – Sphagnum	Pl[1] Sb[1] Sx[1,32]				400	200	200	4	9	15	Pl 1.4 Others 0.8	150
31 Non-forested bog	non-forested				–	–	–	–	–	–	– –	–
32 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–

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* avoid logging
1 elevated microsites are preferred
9 restricted to southerly aspects

18 restricted to eastern portion of biogeoclimatic unit in region
32 limited by growing-season frosts

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility (#a on freely drained phase of 07)

Continued next page

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[+] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBSdk — Prince Rupert (continued)

Site series	Conifer species			Broadleaf species^	Stocking standards (well-spaced/ha) •			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
81 Saskatoon – Slender wheatgrass	non-forested				–	–	–	–	–	–	– –	–
82 Bluegrass – Slender wheatgrass	non-forested				–	–	–	–	–	–	– –	–

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^ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBSmc2 — Prince Rupert

Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)		% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)			
01 Sxw – Huckleberry	Pl Sx	Bl[29]		At[a]	1200	700	600	7	12	15	Pl Others	1.6 0.8	150
02* Pl – Huckleberry – Cladonia	Pl		Bl[32] Sx[32]	At[b]	1000	500	400	7	12	15	Pl Others	1.2 0.6	150
03 SbPl – Feathermoss	Pl	Bl[29] Sb Sx[32]		At[b]	1200	700	600	7	12	15	Pl Others	1.6 0.8	150
04‡ Sxw – Huckleberry – Dwarf blueberry	Pl Sx	Bl[29]		At[b]	1200	700	600	4	9	15	Pl Others	1.6 0.8	150
05 Sxw – Twinberry – Coltsfoot	Pl Sx	Bl[29]		Act[a] At[a]	1200	700	600	4	9	15	Pl Others	1.6 0.8	150
06 Sxw – Oak fern	Pl Sx	Bl[29]		Act[b] At[a]	1200	700	600	4	9	15	Pl Others	1.6 0.8	150
07* Sxw – Scrub birch – Feathermoss	Pl Sb Sx[32]		Bl	At[b]	1000	500	400	4	9	15	Pl Others	1.2 0.6	150

* avoid logging
‡ only in Cariboo Region
29 risk of heavy browsing by moose

32 limited by growing-season frosts
a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

Continued next page

Δ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

• **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBSmc2 — Prince Rupert (continued)

Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
08‡ Sxw – Twinberry – Oak fern	Pl Sx	Bl[29]		Act[b] At[a]	1200	700	600	4	9	15	Pl 1.6 Others 0.8	150
09 Sxw – Devil's club	Sx	Bl[29] Pl		Act[b] At[a]	1200	700	600	4	9	15	Pl 1.6 Others 0.8	150
10 Sxw – Horsetail	Sx[1,32]	Bl[1,29,32] Pl[1]		Act[b] At[b]	1000	500	400	4	9	15	Pl 1.2 Others 0.6	150
11‡ Sxw – Horsetail – Glow moss	Sx[1,32]	Bl[1,29,32] Pl[1]		Act[b]	1000	500	400	4	9	15	Pl 1.2 Others 0.6	150
12* SbSxw – Scrub birch – Sedge	Pl[1] Sb[1] Sx[1,32]		Bl[1]		400	200	200	4	9	15	Pl 1.2 Others 0.6	150
31 Non-forested fen/marsh	non-forested				–	–	–	–	–	–	– –	–

* avoid logging
‡ not found in region
1 elevated microsites are preferred
29 risk of heavy browsing by moose

32 limited by growing-season frosts
a productive, reliable, and feasible regeneration option

b limited in productivity, reliability, and/or feasibility (#a on fluvial phases of 09 and 10)

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBSwk3 — Prince Rupert

Site series	Conifer species			Broadleaf species[Δ]	Stocking standards (well-spaced/ha)[•]			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
01 Sxw – Oak fern	Pl Sx	Bl[29]		Act[b] At[a] Ep[a]	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
02 Pl – Huckleberry – Cladina	Pl		Bl[28] Sx[28]		1000	500	400	7	12	15	Pl 1.4 Others 0.8	150
03 SxwFd – Purple peavine	Fd[16] Pl	Sx[28]		At[b] Ep[b]	1200	700	600	7	12	15	Pl 2.0 Fd 1.4 Sx 1.0	150
04 Sxw – Huckleberry – Highbush-cranberry	Pl Sx	Bl		At[a] Ep[a]	1200	700	600	7	12	15	Pl 2.0 Others 1.0	150
05 Sb – Labrador tea	Pl		Sb Sx	At[b]	1200	700	600	7	12	15	Pl 2.0 Others 1.0	150
06 Sxw – Twinberry – Coltsfoot	Pl Sx	Bl[29]		Act[b] At[a] Ep[a]	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150

[16] restricted to southern portion of biogeoclimatic unit in region

[28] limited by moisture deficit

[29] risk of heavy browsing by moose

[a] productive, reliable, and feasible regeneration option

[b] limited in productivity, reliability, and/or feasibility

Continued next page

[Δ] See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines

[•] **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

SBSwk3 — Prince Rupert (continued)

Tree Species Selection and Free Growing Stocking Standard Guidelines

Site series	Conifer species			Broadleaf species$^{\Delta}$	Stocking standards (well-spaced/ha)$^{+}$			Regen delay (yrs)	Assessment		Min. tree height (m)	% tree over brush
	Primary	Secondary	Tertiary		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
07 Sxw – Devil's club	Sx^{32}	$Bl^{29,32}$ Pl		Act^{b} At^{a} Ep^{a}	1200	700	600	4	9	15	Pl 2.0 Others 1.0	150
08 Sxw – Horsetail	$Sx^{1,32}$	$Bl^{1,29,32}$ Pl^{1}		Act^{a} At^{a}	1000	500	400	4	9	15	Pl 1.4 Others 0.8	150

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1 elevated microsites are preferred
29 risk of heavy browsing by moose
32 limited by growing-season frosts

a productive, reliable, and feasible regeneration option
b limited in productivity, reliability, and/or feasibility

$^{\Delta}$ See Interior Broadleaf guidelines on page 90 for stocking standard and free growing guidelines
$^{+}$ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

Broadleaf — Interior*

Tree Species Selection and Free Growing Stocking Standard Guidelines**

Target from conifer standards (stems/ha)	Hardwood stocking standards (well-spaced/ha) +			Regen delay (yrs)	Assessment		Min. inter-tree distance (m)	% tree over brush
	TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
400	600	400	400	4	9	12	2	150
600	1000	500	400	4	9	12	2	150
1000	1200	1000	800	4	9	12	2	150
1200	2000	1200	1000	4	9	12	2	150

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* Cariboo, Kamloops, Nelson, Prince George and Prince Rupert forest regions

** The minimum height for broadleaf trees is based on the minimum height of the tallest conifer for the site series. These standards apply to pure broadleaf stands (black cottonwood, trembling aspen, paper birch, and balsam poplar) for oriented strand board and sawlog production objectives.

+ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

Broadleaf — Coast*

Tree Species Selection and Free Growing Stocking Standard Guidelines**

Tree species	Product	Stocking standards (well-spaced/ha)+			Regen delay (yrs)	Assessment		Min. inter-tree distance (m)	% tree over brush
		TSSpa	MSSpa	MSSp		Early (yrs)	Late (yrs)		
Red alder‡ and bigleaf maple	Sawlogs	1200	700	600	3	5	8	2	150
	Pulp	1500	1200	1000	3	5	8	2	150
Coastal black cottonwood (for pulp)	Sawlogs	700	400	400	3	5	8	2	150
	Pulp	900	600	500	3	5	8	2	150

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* Vancouver Forest Region and the CWH zone of the Prince Rupert Forest Region

** The minimum height for broadleaf trees is based on the minimum height of the tallest conifer for the site series. These standards apply to pure broadleaf stands.

+ **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

‡ When growing red alder for sawlog production, it is recommended that stands be thinned to 600 well-spaced trees per hectare, but not before the stands have reached 12 to 16 m in height.

Uneven-aged Stocking Standards* — Single-tree selection only

Target from even-aged standards (stems/ha)	Layer**	Stocking standards (well-spaced/ha)***		
		TSSpa	MSSpa	MSSp
1200	1	600	300	250
	2	800	400	300
	3	1000	500	400
	4	1200	700	600
1000	1	400	200	200
	2	600	300	250
	3	800	400	300
	4	1000	500	400
900	1	400	200	200
	2	500	300	250
	3	700	400	300
	4	900	500	400
800	1	300	150	150
	2	400	200	200
	3	600	300	300
	4	800	400	400
600	1	300	150	150
	2	400	200	200
	3	500	300	300
	4	600	400	400
400	1	200	100	100
	2	300	125	125
	3	300	150	150
	4	400	200	200

May 2000

* Maximum regeneration delay is seven years. For a seven-year regeneration delay, the early free growing is 12 years and the late free growing is 15 years. Regeneration delay can be met immediately following harvest if the residual stand has no significant damage or pest problems and meets minimum stocking standards. If regeneration is achieved immediately following harvest, earliest free growing date is five years post harvest and late free growing assessment is at 15 years.

** **Layer 1** = mature layer = trees ≥ 12.5 cm dbh; **Layer 2** = pole layer = trees 7.5 cm to 12.4 cm dbh;
Layer 3 = sapling layer = trees ≥ 1.3 m in height and up to 7.4 cm dbh; **Layer 4** = regeneration layer = trees < 1.3 m in height

*** **TSS** – target stocking standards **MSS** – minimum stocking standards **pa** – preferred and acceptable **p** – preferred

Appendix 1. Synopsis of selected silvical characteristics

Species	Distribution along the climatic gradient (in the forested biogeoclimatic zones)										Distribution along the soil moisture gradient						Distribution along the soil nutrient gradient						Shade tolerance						Potential for natural regeneration		Spatial requirements	Special adaptations and indicative values
	MH	ESSF & MS	BWBS	SBS	SBPS	IDF	ICH	PP	CDF	CWH	very dry	dry	fresh	moist	wet	ranking*	very poor	poor	medium	rich	very rich	ranking*	very shade-tolerant	shade-tolerant	moderately shade-tolerant	shade-intolerant	very shade-intolerant	ranking*	in the shade	in the open		
Pacific silver fir	⬤	○					○			•		○	⬤	⬤	○	16	○	•	⬤	⬤	○	8	⬤	•	○			1	H	L	L	heavy snow cover- & flood-tolerant; indicator of maritime, wet (snowy) climates
Grand fir						•	•		•	○		○	⬤	⬤	○	16		○	•	⬤	⬤	18	○	•	⬤	⬤	○	8	L	L	M	fluctuating water table & flood-tolerant; indicator of nutrient-rich sites
Subalpine fir	○	⬤	•	⬤	○	○	•			○	○	•	⬤	⬤	•	18	○	•	⬤	⬤	•	9	○	⬤	⬤	•	○	3	H	L	L	frost-, heavy snow cover- & flood-tolerant; at high elevations, vegetative reproduction by layering
Tamarack			•	○									○	•	⬤	26			○	⬤	•	16					⬤	26	L	M	H	frost- & flood-tolerant; indicator of continental boreal, moist to wet & nutrient-rich sites
Subalpine larch		•									○	⬤	•			4		○	⬤	•	○	6				○	⬤	22	L	M	H	frost-tolerant; indicator of continental subalpine boreal climates
Western larch		•				⬤	•	○			○	⬤	•	○		5		○	•	⬤	•	14				○	⬤	18	L	M	H	frost-tolerant; deep & wide-spreading root system; indicator of continental temperate climates
Engelmann spruce	○	⬤		•	○	○	•			○	○	•	⬤	⬤	○	18		•	⬤	⬤	•	12		○	•	⬤	•	12	L-M	M	M	frost-, heavy snow cover- & flood-tolerant
White spruce		○	⬤	⬤	•	○	○			○		•	⬤	⬤	○	15		○	•	⬤	⬤	18		○	•	⬤	•	11	L-M	M	H	frost- & flood-tolerant; indicator of continental boreal climates
Black spruce			⬤	•	○		○					○	•	⬤	⬤	23	⬤	⬤	•	○		2	○	•	⬤	○		6	M	L	L	persistent & semi-serotinous cones; vegetative reproduction by layering; frost-tolerant; indicator of continental boreal climates & nutrient-poor sites
Sitka spruce	○								○	•		○	•	⬤	•	21			○	•	⬤	25			○	⬤	•	14	L	H	H	frost & snow-intolerant; ocean spray-, brackish water- & flood-tolerant; indicator of wet mesothermal climates
Whitebark pine	○	•									•	⬤	•	○		5		•	⬤	•		7				○	⬤	18	L	L	H	regeneration largely from seed caches of Clark's nutcracker; frost-tolerant indicator of subalpine boreal climates
Jack pine			○								•	⬤	○			3	⬤	⬤	•			1				○	⬤	22	L	L	H	serotinous cones; frost-tolerant; indicator of continental boreal climates and dry & nutrient-poor sites
Lodgepole pine	○	⬤	⬤	⬤	⬤	⬤	•		○	•	•	⬤	•	○	○	7	⬤	⬤	⬤	○		3			○	•	⬤	17	L	L-H	L-M	serotinous cones; frost-tolerant
Limber pine		○				○					⬤	•	○			2			•	⬤		15				○	⬤	18	L	L	H	regeneration largely from seed caches of Clark's nutcracker; frost-tolerant; calciphytic; indicator of continental subalpine boreal climates
Western white pine	○	○				○	•		○	•		○	⬤	•	○	12		○	•	⬤	⬤	18	○	•	⬤	⬤	•	9	L-M	L-M	M-H	flood-tolerant
Ponderosa pine		○				•	○	⬤			⬤	⬤	•	○		1		○	•	⬤	⬤	18			○	⬤	•	15	L	L	H	moderately frost- & flood-tolerant; calciphytic; indicator of dry sites
Douglas-fir	○	•		•	○	⬤	•	○	⬤	•	○	⬤	⬤	•		8	○	•	⬤	⬤	•	9	○	•	⬤	⬤	•	10	L-M	M-H	M	flood- & heavy snow cover-intolerant
Western hemlock	○	○				○	⬤		○	⬤		○	⬤	•	○	10	⬤	⬤	⬤	○		3	•	⬤	•			2	H	H	L	indicator of acid substrates
Mountain hemlock	⬤	○		○			○			○		○	⬤	•	○	10	⬤	⬤	⬤	○		3	○	•	⬤	○		4	M	M	M	heavy snow cover-tolerant; indicator of acid substrates
Alaska yellow-cedar	⬤	○								•		○	•	⬤	⬤	23	○	•	⬤	⬤	•	9	○	•	⬤	○		6	L-M	M	L	frost-intolerant, heavy snow cover-tolerant; indicator of maritime wet (snowy) climates
Western redcedar	○	○		○		•	⬤		•	⬤	○	•	⬤	⬤	•	18	○	•	•	⬤	⬤	17	○	•	⬤	○		4	M	M-H	L	flood-tolerant
Balsam poplar & black cottonwood	○	○	•	•	•	○	•	○	•	○		○	•	⬤	○	25			○	•	⬤	18				○	⬤	22	L	H	H	vegetative reproduction from root & stump sprouts; frost- & flood-tolerant; indicator of fresh to moist & nutrient-rich (alluvial) sites
Trembling aspen		•	⬤	⬤	•	•	•	○	○	○	○	•	⬤	⬤	○	13		○	•	⬤	⬤	18			○	•	⬤	16	L	H	H	vegetative reproduction from root suckers & sprouts & stump sprouts
Red alder									•	⬤	○	•	⬤	⬤	⬤	22		○	•	⬤	⬤	18				○	⬤	18	L	H	H	in symbiosis with N-fixing Actinomyces alni; vegetative reproduction from stump sprouts; frost- & snow-intolerant, flood-tolerant; indicator of mesothermal climates
Bigleaf maple						○			⬤	•		○	•	⬤	○	14			○	•	⬤	25			○	⬤	•	13	L	H	H	vegetative reproduction from stump sprouts; frost-intolerant, flood-tolerant; indicator of maritime climates & nutrient-rich sites
Paper birch		○	•	•	○	•	•	○	○	○	○	•	⬤	•	○	9		○	⬤	⬤	•	13				○	⬤	22	L	H	H	vegetative reproduction from stump sprouts; frost- & flood-tolerant

⬤ very frequent • frequent ○ less frequent ☐ absent

L low
M medium
H high

* Approximate comparative ranking of the species along the gradients (±2 or 3 of the 26 species listed); i.e., 1 – driest soils, nutrient-poorest soils, or most shade-tolerant to 26 – wettest soils, nutrient-richest soils, or most shade-intolerant.

Source Klinka, K., M.C. Feller, R. Green, D. Meidinger, J. Pojar, and J. Worrall. 1990. Ecological Principles: Applications. *In* Lavender *et al.* 1990. Regenerating British Columbia's forests. Univ. BC Press, Vancouver, B.C. pp. 55–72.

Reproduction methods that favour tree species with different protection requirements and shade tolerances (modified from Klinka and Carter 1991)

Requiring protection	Exposure tolerant		Requiring exposure
Shade tolerant	Shade tolerant	Moderately shade tolerant	Shade intolerant
group selection	clearcutting	clearcutting	clearcutting
single-tree selection			
	uniform seed-tree	uniform seed-tree	uniform seed-tree
group shelterwood	grouped seed-tree	grouped seed-tree	
uniform shelterwood			grouped seed-tree
strip shelterwood	group selection	strip selection	
irregular shelterwood	single-tree selection	group selection	
nurse-tree shelterwood			group shelterwood
	group shelterwood	group shelterwood	
release cutting*	uniform shelterwood	uniform shelterwood	strip shelterwood
	strip shelterwood	strip shelterwood	
	irregular shelterwood		
	nurse-tree shelterwood	release cutting*	
	release cutting*		

* Also known as natural shelterwood or overstorey removal, which releases an existing natural understorey.

Note: Reserves of uncut trees can be used with any of the above systems.

Appendix 2. Tree species codes and biogeoclimatic units of British Columbia

Species symbol	Common name	Scientific name
Conifers		
Ba	amabilis fir	*Abies amabilis*
Bg	grand fir	*Abies grandis*
Bl	subalpine fir	*Abies lasiocarpa*
Bp	noble fir	*Abies procera*
Cw	western redcedar	*Thuja plicata*
Fd	Douglas-fir	*Pseudotsuga menziesii*
Hm	mountain hemlock	*Tsuga mertensiana*
Hw	western hemlock	*Tsuga heterophylla*
Lt	tamarack	*Larix laricina*
Lw	western larch	*Larix occidentalis*
Pa	whitebark pine	*Pinus albicaulis*
Pl	lodgepole pine	*Pinus contorta*
Pw	western white pine	*Pinus monticola*
Py	ponderosa pine	*Pinus ponderosa*
Sb	black spruce	*Picea mariana*
Se	Engelmann spruce	*Picea engelmannii*
Ss	Sitka spruce	*Picea sitchensis*
Sw	white spruce	*Picea glauca*
Sx	hybrid spruce	*Picea hybrids*
Sxs	hybrid Sitka spruce	*Picea sitchensis* x *glauca*
Sxw	hybrid white spruce	*Picea engelmannii* x *glauca*
Yc	yellow-cedar	*Chamaecyparis nootkatensis*
Broadleaf trees		
Act	black cottonwood	*Populus balsamifera* ssp. *trichocarpa*
Acb	balsam poplar	*Populus balsamifera* ssp. *balsamifera*
At	trembling aspen	*Populus tremuloides*
Dr	red alder	*Alnus rubra*
Ep	common paper birch	*Betula papyrifera*
Mb	bigleaf maple	*Acer macrophyllum*
Qg	Garry oak	*Quercus garryana*
Ra	arbutus	*Arbutus menziesii*

Biogeoclimatic units of British Columbia

Zone	Subzone	Variant	Name
AT			Alpine Tundra
BG			Bunchgrass
	BGxh		Very Dry Hot BG
		BGxh1	Okanagan BGxh
		BGxh2	Thompson BGxh
		BGxh3	Fraser BGxh
	BGxw		Very Dry Warm BG
		BGxw1	Nicola BGxw
		BGxw2	Alkali BGxw
BWBS			Boreal White and Black Spruce
	BWBSdk		Dry Cool BWBS
		BWBSdk1	Stikine BWBSdk
		BWBSdk2	Liard BWBSdk
	BWBSmw		Moist Warm BWBS
		BWBSmw1	Peace BWBSmw
		BWBSmw2	Fort Nelson BWBSmw
	BWBSwk		Wet Cool BWBS
		BWBSwk1	Murray BWBSwk
		BWBSwk2	Graham BWBSwk
		BWBSwk3	Kledo BWBSwk
	BWBSvk		Very Wet Cool BWBS
CDF			Coastal Douglas-fir
	CDFmm		Moist Maritime CDF
CWH			Coastal Western Hemlock
	CWHxm		Very Dry Maritime CWH
		CWHxm1	Eastern CWHxm
		CWHxm2	Western CWHxm
	CWHdm		Dry Maritime CWH
	CWHds		Dry Submaritime
		CWHds1	Southern CWHds
		CWHds2	Central CWHds
	CWHmm		Moist Maritime CWH
		CWHmm1	Submontane CWHmm
		CWHmm2	Montane CWHmm
	CWHms		Moist Submaritime CWH
		CWHms1	Southern CWHms
		CWHms2	Central CWHms
	CWHwh		Wet Hypermaritime
		CWHwh1	Submontane CWHwh
		CWHwh2	Montane CWHwh
	CWHwm		Wet Maritime
	CWHws		Wet Submaritime
		CWHws1	Submontane CWHws
		CWHws2	Montane CWHws
	CWHvh		Very Wet Hypermaritime
		CWHvh1	Southern CWHvh
		CWHvh2	Central CWHvh
	CWHvm		Very Wet Maritime
		CWHvm1	Submontane CWHvm
		CWHvm2	Montane CWHvm
		CWHvm3	Central CWHvm

Zone	Subzone	Variant	Name
ESSF			Engelmann Spruce – Subalpine Fir
	ESSFxc		Very Dry Cold ESSF
	ESSFxv		Very Dry Very Cold ESSF
		ESSFxv1	West Chilcotin ESSFxv
		ESSFxv2	Big Creek ESSFxv
	ESSFdk		Dry Cool ESSF
	ESSFdc		Dry Cold ESSF
		ESSFdc1	Okanagan ESSFdc
		ESSFdc2	Thompson ESSFdc
	ESSFdv		Dry Very Cold ESSF
	ESSFmw		Moist Warm ESSF
	ESSFmm		Moist Mild ESSF
		ESSFmm1	Raush ESSFmm
		ESSFmm2	Robson ESSFmm
	ESSFmk		Moist Cool ESSF
	ESSFmc		Moist Cold ESSF
	ESSFmv		Moist Very Cold ESSF
		ESSFmv1	Nechako ESSFmv
		ESSFmv2	Bullmoose ESSFmv
		ESSFmv3	Omineca ESSFmv
		ESSFmv4	Graham ESSFmv
	ESSFwm		Wet Mild ESSF
	ESSFwk		Wet Cool ESSF
		ESSFwk1	Cariboo ESSFwk
		ESSFwk2	Misinchinka ESSFwk
	ESSFwc		Wet Cold ESSF
		ESSFwc1	Columbia ESSFwc
		ESSFwc2	Northern Monashee ESSFwc
		ESSFwc3	Cariboo ESSFwc
		ESSFwc4	Selkirk ESSFwc
	ESSFwv		Wet Very Cold ESSF
	ESSFvc		Very Wet Cold ESSF
	ESSFvv		Very Wet Very Cold ESSF
	ESSFxcp		Very Dry Cold Parkland ESSF
	ESSFxvp		Very Dry Very Cold Parkl. ESSF
		ESSFxvp1	West Chilcotin ESSFxvp
		ESSFxvp2	Big Creek ESSFxvp
	ESSFdkp		Dry Cool Parkland ESSF
	ESSFdcp		Dry Cold Parkland ESSF
		ESSFdcp1	Okanagan ESSFdcp
		ESSFdcp2	Thompson ESSFdcp
	ESSFdvp		Dry Very Cold Parkland ESSF
	ESSFmwp		Moist Warm Parkland ESSF
	ESSFmmp		Moist Mild Parkland ESSF
		ESSFmmp1	Raush ESSFmmp
		ESSFmmp2	Robson ESSFmmp
	ESSFmkp		Moist Cool Parkland ESSF
	ESSFmcp		Moist Cold Parkland ESSF
	ESSFmvp		Moist Very Cold Parkland ESSF
		ESSFmvp1	Nechako ESSFmvp
		ESSFmvp2	Bullmoose ESSFmvp
		ESSFmvp3	Omineca ESSFmvp
		ESSFmvp4	Graham ESSFmvp
	ESSFwmp		Wet Mild Parkland ESSF

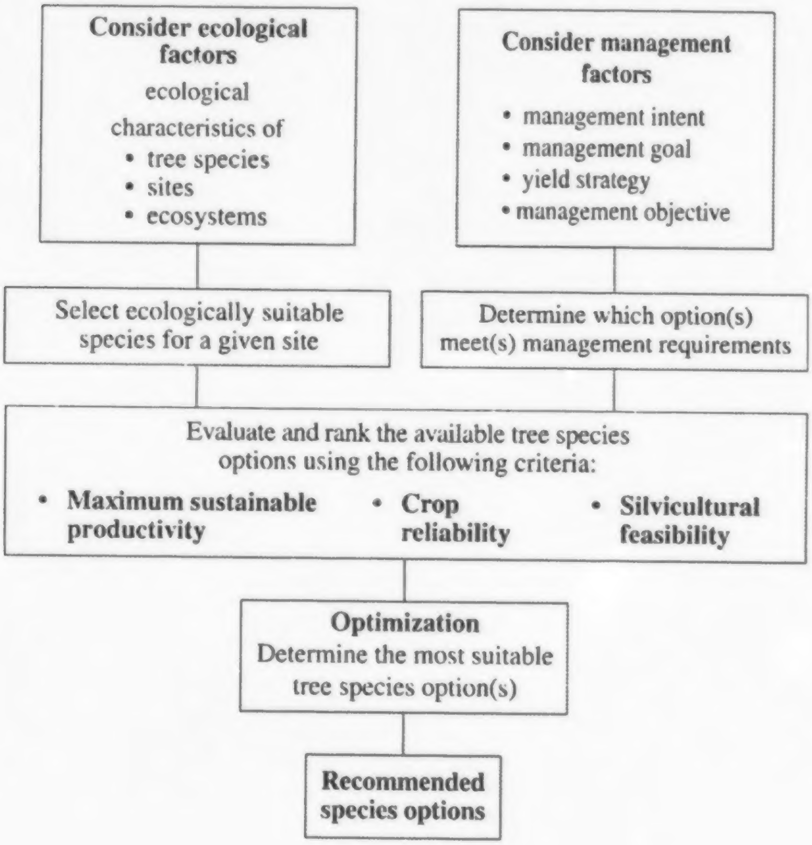
Zone	Subzone	Variant	Name
	ESSFwcp		Wet Cold Parkland ESSF
		ESSFwcp2	Northern Monashee ESSFwcp
		ESSFwcp3	Cariboo ESSFwcp
		ESSFwcp4	Selkirk ESSFwcp
	ESSFwvp		Wet Very Cold Parkland ESSF
	ESSFvcp		Very Wet Cold Parkland ESSF
	ESSFvvp		Very Wet Very Cold Parkland ESSF
ICH			Interior Cedar – Hemlock
	ICHxw		Very Dry Warm ICH
	ICHdw		Dry Warm ICH
	ICHdk		Dry Cool ICH
	ICHmw		Moist Warm ICH
		ICHmw1	Golden ICHmw
		ICHmw2	Columbia-Shuswap ICHmw
		ICHmw3	Thompson ICHmw
	ICHmm		Moist Mild ICH
	ICHmk		Moist Cool ICH
		ICHmk1	Kootenay ICHmk
		ICHmk2	Thompson ICHmk
		ICHmk3	Horsefly ICHmk
	ICHmc		Moist Cold ICH
		ICHmc1	Nass ICHmc
		ICHmc1a	Amabilis Fir Phase, ICHmc1
		ICHmc2	Hazelton ICHmc
	ICHwk		Wet Cool ICH
		ICHwk1	Wells Gray ICHwk
		ICHwk1c	Cold Air Phase, ICHwk1
		ICHwk2	Quesnel ICHwk
		ICHwk3	Goat ICHwk
		ICHwk4	Cariboo ICHwk
	ICHwc		Wet Cool ICH
	ICHvk		Very Wet Cool ICH
		ICHvk1	Mica ICHvk
		ICHvk1c	Cold Air Phase, ICHvk1
		ICHvk2	Slim ICHvk
	ICHvc		Very Wet Cold ICH
IDF			Interior Douglas-fir
	IDFxh		Very Dry Hot IDF
		IDFxh1	Okanagan IDFxh
		IDFxh1a	Grassland Phase, IDFxh1
		IDFxh1b	Steep South Phase, IDFxh1
		IDFxh2	Thompson IDFxh
		IDFxh2a	Grassland Phase, IDFxh2
		IDFxh2b	Steep South Phase, IDFxh2
	IDFxw		Very Dry Warm IDF
	IDFxm		Very Dry Mild IDF
	IDFdm		Dry Mild IDF
		IDFdm1	Kettle IDFdm
		IDFdm2	Kootenay IDFdm

Zone	Subzone	Variant	Name
	IDFdk		Dry Cool IDF
		IDFdk1	Thompson IDFdk
		IDFdk1a	Grassland Phase, IDFdk1
		IDFdk1b	Steep South Phase, IDFdk1
		IDFdk2	Cascade IDFdk
		IDFdk2b	Steep South Phase, IDFdk2
		IDFdk3	Fraser IDFdk
		IDFdk4	Chilcotin IDFdk
	IDFdw		Dry Warm IDF
	IDFmw		Moist Warm IDF
		IDFmw1	Okanagan IDFmw
		IDFmw2	Thompson IDFmw
		IDFmw2a	Grassland Phase, IDFmw
	IDFww		Wet Warm IDF
MH			Mountain Hemlock
	MHmm		Moist Maritime MH
		MHmm1	Windward MHmm
		MHmm2	Leeward MHmm
	MHwh		Wet Hypermaritime MH
		MHwh1	Windward MHwh
		MHwh2	Leeward MHwh
	MHmmp		Moist Maritime Parkland MH
		MHmmp1	Windward MHmmp
		MHmmp2	Leeward MHmmp
		MHwhp	Wet Hypermaritime Parkland MH
		MHwhp1	Windward MHwhp
		MHwhp2	Leeward MHwhp
MS			Montane Spruce
	MSxk		Very Dry Cool MS
	MSxv		Very Dry Very Cold MS
	MSdm		Dry Mild MS
		MSdm1	Okanagan MSdm
		MSdm2	Thompson MSdm
	MSdk		Dry Cool MS
	MSdc		Dry Cold MS
		MSdc1	Bridge MSdc
		MSdc2	Tatlayoko MSdc
	MSdv		Dry Very Cold MS
PP			Ponderosa Pine
	PPxh		Very Dry Hot PP
		PPxh1	Okanagan PPxh
		PPxh1a	Grassland Phase, PPxh1
		PPxh2	Thompson PPxh
		PPxh2a	Grassland Phase, PPxh2
	PPdh		Dry Hot PP
		PPdh1	Kettle PPdh
		PPdh2	Kootenay PPdh
SBPS			Sub-Boreal Pine – Spruce
	SBPSxc		Very Dry Cold SBPS
	SBPSdc		Dry Cold SBPS
	SBPSmk		Moist Cool SBPS
	SBPSmc		Moist Cold SBPS

Zone	Subzone	Variant	Name
SBS			Sub-Boreal Spruce
	SBSdh		Dry Hot SBS
		SBSdh1	McLennan SBSdh
		SBSdh2	Robson SBSdh
	SBSdw		Dry Warm SBS
		SBSdw1	Horsefly SBSdw
		SBSdw2	Blackwater SBSdw
		SBSdw3	Stuart SBSdw
	SBSdk		Dry Cool SBS
	SBSmh		Moist Hot SBS
	SBSmw		Moist Warm SBS
	SBSmm		Moist Mild SBS
	SBSmk		Moist Cool SBS
		SBSmk1	Mossvale SBSmk
		SBSmk2	Williston SBSmk
	SBSmc		Moist Cold SBS
		SBSmc1	Moffat SBSmc
		SBSmc2	Babine SBSmc
		SBSmc3	Kluskus SBSmc
	SBSwk		Wet Cool SBS
		SBSwk1	Willow SBSwk
		SBSwk2	Finlay-Peace SBSwk
		SBSwk3	Takla SBSwk
		SBSwk3a	Douglas-fir Phase, SBSwk3
	SBSvk		Very Wet Cool SBS
SWB			Spruce – Willow – Birch
	SWBdk		Dry Cool SWB
	SWBmk		Moist Cool SWB
	SWBdks		Dry Cool Scrub SWB
	SWBmks		Moist Cool Scrub SWB
	SWBvks		Very Wet Cool Scrub SWB

Appendix 3. Conceptual approach to tree species selection

The procedures used for tree species selection in these guidelines are based on work by K. Klinka and M.C. Feller (1984) for forest sites in southwestern British Columbia. These guidelines have been developed with consideration of both ecological and management factors. The evaluation criteria of maximum sustainable productivity, crop reliability, and silvicultural feasibility were stressed throughout the development process. The choice of stocking standards was tied to management objectives.


Consider ecological factors
ecological characteristics of
• tree species
• sites
• ecosystems
Consider management factors
• management intent
• management goal
• yield strategy
• management objective
Select ecologically suitable species for a given site
Determine which option(s) meet(s) management requirements
Evaluate and rank the available tree species options using the following criteria:
• Maximum sustainable productivity
• Crop reliability
• Silvicultural feasibility
Optimization
Determine the most suitable tree species option(s)
Recommended species options

Species evaluation by site series

A list of ecologically acceptable species was prepared for each site series. Three criteria were then used to determine the most suitable species choices for sawlog production (the assumed management goal):

- maximum sustainable productivity
- crop reliability
- silvicultural feasibility.

Maximum sustainable productivity

To satisfy the maximum sustainable productivity criterion, the relative productivity for each tree species, or combination of tree species, was evaluated to determine which were best suited to each ecosystem unit.

Crop reliability

To satisfy the crop reliability criterion, the relative susceptibility to natural hazards was evaluated for each tree species, to determine which species provide the most reliable choices for a future crop on a given site series. Established stands should be both resilient and resistant to all anticipated hazards, so that they will survive until harvest.

Silvicultural feasibility

To satisfy the criterion of silvicultural feasibility, ecologically viable tree species were evaluated, based on accumulated silvicultural experience, to determine whether they were able to produce sawlogs in a cost-effective manner on each site series within an acceptable rotation length.

Appendix 4. Examples of species selection and stocking standards

1. Determining preferred and acceptable species by management objectives

A block is located in a site series for which the guidelines indicate Pl and Sx as primary species and Bl as a secondary species. The guidelines indicate that the free growing target stocking standard is 1200 well-spaced trees/ha and the minimum stocking standard is 700 well-spaced trees/ha.

Reviews of the management unit plan and landscape priorities have identified that the production of Sx sawlogs, in an 80 year rotation, is the main objective for this portion of the landscape. The prescriber has also determined that, for this site, Sx has the best mix of maximum sustainable productivity, crop reliability, and silvicultural feasibility when compared with other species.

Once spruce sawlogs have been identified as the management objective, Sx is listed as the preferred species in the silviculture prescription. Management activities will be aimed at actively managing for Sx through site preparation, planting, and brush control. Since Pl and Bl will not be planted or actively managed for, they will be identified only as acceptable species in the silviculture prescription. Pl and Bl will be considered acceptable for contributing to tree species diversity and additional stocking to the site.

Management activities will be aimed at meeting the target stocking at free growing.

At the regeneration delay date, a minimum of 700 well-spaced preferred and acceptable trees/ha and a minimum of 600 well-spaced Sx/ha must be on-site (see Table 1, page 17) in order to classify the site as satisfactorily restocked.

Within the free growing assessment period, to be classified as free growing, a minimum of 600 free growing Sx/ha must be on-site (see Table 1). In addition, there must be at least 700 free growing preferred and acceptable trees/ha on-site. If there are fewer than 600 free growing Sx/ha, or fewer than 700 total free growing trees/ha, the area is considered not free growing.

The standards are intended to ensure that sufficient numbers of the preferred tree species are established and free growing in order to produce the desired future forest conditions.

2. Tertiary species as preferred

In this example, site classification shows the block to be on a southwest slope in the lower elevation of the ICH. Armillaria root rot is considered a serious threat to future productivity on the block. The original stand was composed of 30% Cw, 40% Hw, and 30% Fd.

Fd and Lw are classed as primary species, Pl and Sx as secondary species, and Bl, Cw, Hw, Pw, and Py as tertiary species. The cautionary and restrictive codes indicate that there is a high risk of blister rust for Pw; that Py be restricted to southerly aspects, at lower elevations, and be used on a trial basis only (as it is out of its natural range); and that Sx be restricted to north aspects and upper elevations. The target and minimum stocking standards provided in the guidelines are 1200 and 700 stems/ha, respectively.

The objective for the stand is to produce sawlog-quality timber over an 80-year rotation, while retaining species diversity. To reduce the incidence of root rot, the block is prescribed to be stumped after harvest.

To ensure the maximum productivity on the site and to reduce the chance of future armillaria root rot infection, a mix of species is prescribed for the new stand. Crown closure is estimated to occur in 30 years.

No snags are to be left in this block, but adjacent riparian areas will be left unharvested to provide perching habitat.

The preferred species chosen in the silviculture prescription to create the target stand are Lw, Fd, Pw, and Py, even though Pw and Py are classed as tertiary species. Lw, Fd, and Py will be planted. Because Py is potentially a productive and reliable species on this site, a monitoring program will be established to assess performance. Pw is expected to fill in naturally. Blister rust is not presently a problem in the stand, however, pruning of Pw is prescribed to mitigate possible infection.

Acceptable species in the silviculture prescription are Bl, Cw, and Hw (all classed as tertiary). These species are thought useful in providing varied habitat and structural diversity. Bl, Cw, and Hw will occur naturally, and no management is required for their establishment. Pl and Sx are not listed in the silviculture prescription as either preferred or acceptable, because there is no Pl seed source on site and Sx is not adapted to this aspect or elevation.

The area will be planted at 1000 stems/ha, with an expected infill of 200 well-spaced stems from the preferred and acceptable species, to provide 1200 stems/ha at free growing.

3. Deviation from the established stocking standards is recommended for maintenance of grizzly bear habitat

After a field check with Ministry of Environment staff, the block was identified as providing critical grizzly bear habitat. The block is near a local skunk cabbage swamp that has bear-marked trees in it.

Harvesting in the valley is near the end of the first pass, where large areas of this site series have been clearcut and regenerated successfully to target stocking levels of Ss. There is a concern that forage availability is becoming constrained due to the ensuing canopy closure in these adjacent areas.

The species guidelines suggest Ba, Cw, and Ss as the primary species. Hw on deep duff is suggested as a secondary species, and Yc is suggested as a tertiary species. The target and minimum stocking standards are suggested as 900 and 500 well-spaced stems/ha, respectively, with a regeneration delay of three years.

Both Ss and Ba are listed as preferred species while Cw, Hw, and Yc are listed as acceptable species in the silviculture prescription. The target stocking is 600 well-spaced stems/ha, with a minimum of 400 well-spaced stems/ha. This is below the 900/500 suggested in these guidelines, but fits within the *Guidelines for integrating grizzly bear habitat and silviculture in the coastal western hemlock biogeoclimatic zone.*

The prescription calls for planting equal numbers of Ss and Ba in clumps of seven trees. Ss is to be planted on the outside of the clumps with Ba in the centres. The minimum inter-tree distance is 1 m. The clumps will be approximately 10 m apart, providing 100 clusters per hectare. Due to brush encroachment and lack of adjacent seed sources, natural regeneration is not expected to influence stocking on this block.

The reduced targets and minimums as well as the clumpy distribution are suggested to allow greater space for colonization and maintenance of key forage species for grizzly bears. The target stand at rotation will provide approximately 450 stems at 80 years with partial canopy closure.

To ensure that the conifers reach free growing, two brushing treatments are scheduled, two and five years after planting. Either backpack spot treatment or manual brushsaw vegetation control methods are suggested. Competing species include red elderberry, salmonberry, and red-osier dogwood. Either treatment should treat only a cylinder around each tree. Control of brush outside the zone of influence is not prescribed. It is intended that crop-tree-centred brushing and clustered conifer spacing will provide adequate space for shrub regrowth, and will provide conditions suitable for adequate berry production through the young sapling and pole stages (5–30 cm dbh).

Appendix 5. Free growing damage criteria for British Columbia

Introduction

Before a stand can be declared free growing, it must have adequate stocking of healthy, well-spaced trees of a preferred or acceptable species. The free growing damage criteria identified in the attached guidelines are not legislated regulations. The guidelines are based on the most current knowledge of forest-damaging agents, and are provided to help users exercise their professional judgment in identifying "healthy" trees. The district manager may allow or require deviations from these guidelines, as long as the legal requirement to produce a healthy tree is met.

These free growing damage criteria are intended to help users uniformly define "healthy" as part of "healthy, well-spaced trees" used in the *Forest Practices Code of British Columbia Act* and regulations. These damage criteria are designed for use at the free growing assessment to determine the damage to, and acceptability of, individual trees (conifers only) across the province. Acceptability of a stand will depend on several factors including thresholds of damage and stocking standards agreed to in the prescription.

The table lists various types of damage, causal agents, and species of trees. Agents and damage are often referred to by their codes listed on the Ministry of Forests Integrated Data Dictionary Pest_Species_Code list (partly listed on the *Silviculture Damage Agent and Condition Codes* (FS 747) field form). Tree species abbreviations are listed in the Forest Productivity Council publication *Minimum Standards for the Establishment and Remeasurement of Permanent Sample Plots in British Columbia* (1999).

There are two key points to keep in mind when using these criteria:

1. These criteria apply **only** at the time the free growing survey is conducted and are specific to even-aged, age class 1 stands that are being regenerated primarily to coniferous species for the production of timber. The assumptions made on the impact of pest damage to potential crop trees are founded on these factors.
2. Broadleaf species are noted in these criteria (usually as non-susceptible host species) but there are no damage criteria listed for these species. This is because the characteristics of most broadleaf species (e.g., pests and growth habits) are sufficiently different from those of conifers that creating a single table would be difficult and confusing. It is envisioned that broadleaf species, and partial-cut stands (age class 2 and older), will be covered by separate tables in the future.

These criteria are based on best available data and professional opinion, and are expected to be revised in future with newly available knowledge or information.

Table A5-1. Free growing damage criteria for even-aged (age class 1) coniferous trees

PLEASE READ the preceding introduction before using the following table and figures.

Location of damage	Type of damage	Tree being assessed is UNACCEPTABLE if:	Host species	Likely damage agents & damage agent codes	Comments
Stem	**Wound** (including sunscald and girdling)	• the tree has any wound which is greater than 33% of the stem circumference, or • the tree has a wound which is greater than 20% of the total length of the stem, or • the tree has a wound centred on an infection caused by a stem rust, canker, or dwarf mistletoe (See Note under Stem: Infection).	All	squirrel AS, beaver AZ, vole AV, porcupine AP, hare AH, Warrens root collar weevil IWW, sequoia pitch moth ISQ, fire NB, windthrow NW, sunscald NZ, logging TL, mechanical TM.	A **wound** is defined as an injury in which the cambium is dead (e.g., sunscald) or completely removed from the tree exposing the sapwood. Measure the wound across the widest point of the exposed sapwood (or dead cambium when the tree is damaged by sunscald). Healed over wounds (=scars) are acceptable. See Figure A5-1.
Stem	**Insect mining at root collar**	• the tree is currently attacked by a bark-mining insect such as a weevil or a beetle and exhibits symptoms such as foliage discoloration, thinning, and/or reduced height growth increments	Pl, Sx	root collar weevil IWW.	Only trees that are symptomatic should be checked for insect infestation or mining damage. Non-symptomatic trees are presumed to be unaffected by insect mining.
Stem	**Deformation** (including crook, sweep, fork, browse, and dead or broken top)	• the pith is horizontally displaced more than 30 cm from the point of defect and originates above 30 cm from the point of germination.	For sweep, all except Cw and Hw	Defoliators ID, white pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP, northern pitch twig moth ISP, sequoia pitch moth ISQ, cattle AC, deer AD, elk AE, moose AM, frost NG, hail NH, snow NY, drought ND, logging TL, mechanical TM.	For **horizontal displacement** see Figure A5-2.
		• the tree leader has been killed three or more times in the last five years (weevil only).	Sx, Ss, Pl	White pine (spruce) weevil IWS, lodgepole pine terminal weevil IWP.	This criterion applies only for terminal weevil damage.
		• the tree has two or more leaders with no dominance expressed after five years growth and the fork originates above 30 cm from the point of germination.	All	terminal weevils (IWS, IWP), frost NG, animal damage A.	**Leader dominance** occurs when the tallest leader is at least 5 cm taller than the second tallest leader. See Figure A5-3.
		• the tree has a dead or broken top at a point that is >2 cm (>3 cm for the coast) in diameter.	All		
Stem	**Infection** (including cankers and galls)	• any infection occurs on the stem.	All	comandra blister rust DSC, stalactiform blister rust DSS, white pine blister rust DSB, western gall rust DSG, atropellis canker DSA.	**Note:** Wounds caused by rodent feeding around rust cankers should have stem rust recorded as the causal agent.
Branch	**Infection** (cankers)	• an infection occurs on a live branch less than 60 cm from the stem.	Pw, Pl, Py	white pine blister rust DSB, comandra blister rust DSC, stalactiform blister rust DSS.	See Figure A5-4.
Branch	**Galls**	• a gall rust infection occurs on a live branch less than 5 cm from the stem.	Pl, Py	western gall rust DSG.	See Figure A5-4.

Table A5-1. Continued

Location of damage	Type of damage	Tree being assessed is UNACCEPTABLE if:	Host species	Likely damage agents & damage agent codes	Comments
Branch	**Gouting**	• any adelgid gouting occurs on a branch.	Ba, Bg, Bl	balsam woolly adelgid IAB.	**Gouting** is defined as excessive swelling of a branch or shoot caused by balsam woolly adelgid, and is often accompanied by misshapen needles and buds. It is most common on branch tips and at nodes near the ends of branches. Consult a recent distribution map to identify the geographic extent of this pest.
Foliage	**Defoliation**	• >80% of tree foliage has been removed due to defoliating insects or foliage disease.	All	defoliators ID, foliage diseases DF.	
Stem or Branch	**Dwarf mistletoe infection**	• any infection occurs on the stem or a live branch, or • a susceptible tree is located within 10 m of an overtopping tree, which is infected with dwarf mistletoe.	Hw, Pl, Lw, Fd	hemlock dwarf mistletoe DMH, lodgepole pine dwarf mistletoe DMP, larch dwarf mistletoe DML, Douglas-fir dwarf mistletoe DMF.	**Note:** To confirm infection, the surveyor must observe mistletoe aerial shoots or basal cups on regeneration or on live or dead fallen brooms. **Overtopping tree** is a tree that is three or more times taller than the median height of the trees being assessed.
Roots	**Root disease**	• sign(s) or a definitive combination of symptoms of root disease are observed.	All	armillaria root disease DRA, laminated root rot DRL, tomentosus root rot DRT, annosus root disease DRN, blackstain root disease DRB.	**Signs** are direct evidence of the pathogenic fungus including fruiting bodies, distinctive mycelium or rhizomorphs. **Symptoms** include foliar chlorosis or thinning, pronounced resin flow near the root collar, reduced recent leader growth, a distress cone crop, and wood decay or stain. An individual symptom is not sufficient to identify a root disease.
		• infected tree found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRA is **two**, except in BEC zones PPdh1 and 2, IDFxh1, IDFdm1 and 2, MSdk1, and MSdm1 where the multiplier is **one**.	All	armillaria root disease DRA.	**Note:** All conifer species are considered susceptible. Broadleaf species are considered **not susceptible** for survey purposes only. **Example:** How to apply net down for root disease. If root disease-infected trees are found in the plot: 1. In the first sweep, determine the total number of healthy, well-spaced trees using the prescribed minimum inter-tree distance (MITD) (e.g., 12 trees) ignoring the M-value; 2. In a second independent sweep, determine the number of well-spaced **infected** trees (including dead infected trees and for DRT only, infected stumps) using MITD (e.g., one infected tree); 3. Multiply the number from step 2 by the multiplier for the specific root disease and subtract this number from the number of **susceptible** healthy well-spaced trees found in step 1 (e.g., for DRA: 12-1(2) = 10). The result is the maximum number of free growing trees tallied for the plot.
		• infected conifer found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRL is **four**.	Fd, Sx, Se Lw, Ba, Bg	laminated root rot DRL.	**Note:** Bl, Cw, Pl, Pw, Py, and broadleaf species are considered **not susceptible** for survey purposes only.
		• infected conifer or stump found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRT is **two**.	Se, Sx	tomentosus root rot DRT.	**Note:** Ba, Bl, Cw, Fd, Pl, Pw, Py and broadleaf species are considered **not susceptible** for survey purposes only.
		• infected conifer found in plot. See comments for well-spaced tree net down calculation. The multiplier for DRN is **two**.	Ba, Hw, Ss	annosus root rot DRN.	**Note:** Bg, Bl, Cw, Cy, Fd, Hm, Pl, Pw, Py, Sx and broadleaf species are considered **not susceptible** for survey purposes only.

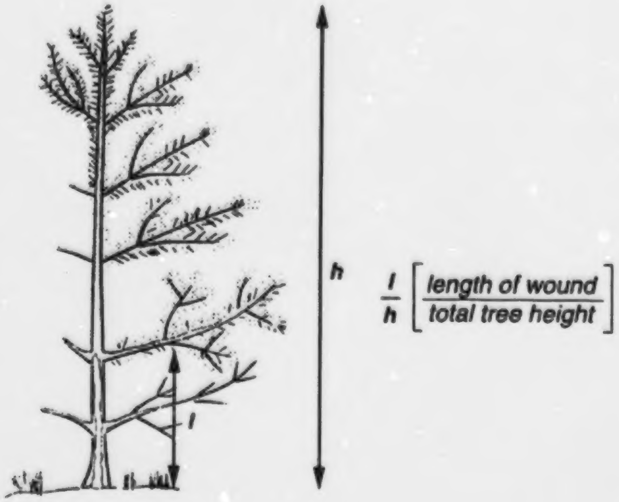

h
l
$\frac{l}{h}\left[\frac{\text{length of wound}}{\text{total tree height}}\right]$

Figure A5-1. Calculation of wound along stem length.

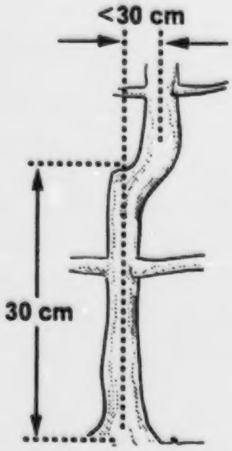


Figure A5-2. Determining horizontal displacement when assessing stem deformation. This is done only when tree has five seasons growth after damage occurs.

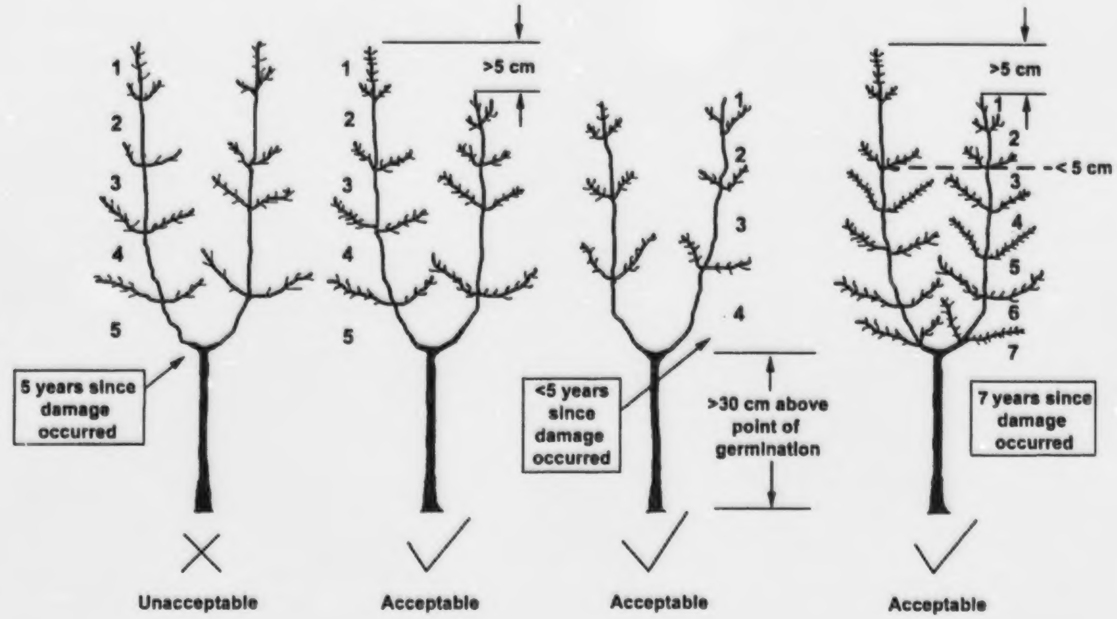

1
2
3
4
5
5 years since damage occurred
Unacceptable
>5 cm
Acceptable
<5 years since damage occurred
>30 cm above point of germination
Acceptable
<5 cm
6
7
7 years since damage occurred
Acceptable

Figure A5-3. Acceptable and unacceptable forks.

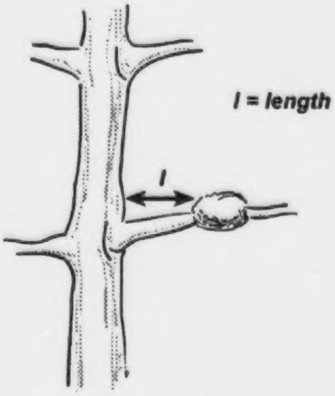


Figure A5-4. Distance measurement from point of infection by canker or gall to main stem.

Definitions

decay: the disintegration of plant tissue. The process by which sound wood is decomposed by the action of wood-destroying fungi and other microorganisms.

fork: two or more leaders have originated from the loss of a leader or apical shoot. At free growing age, a fork is considered persistent if it has not differentiated in height between competing leaders by more than 5 cm after five years of growth since the leader damage occurred. Forks may provide entry points for decay fungi, are points of weakness during felling, and may create waste in the highest value first log.

gall: nodule or lump of malformed bark or woody material caused by a variety of damaging agents, such as western gall rust and some insects.

gouting: excessive swelling of a branch or shoot, often accompanied by misshapen needles and buds. Most common at nodes on branches and frequently caused by balsam woolly adelgid on true firs (*Abies* spp.).

infection: characterized by a lesion or canker on stem or branches or by swelling around the entrance point of a pathogen.

injury: damage to a tree by a biological, physical, or chemical agent.

scar: a wound completely healed over with callus tissue

wound: an injury where cambium is dead (e.g., sunscald) or completely removed. Wounds often serve as entry points for decay fungi.

Appendix 6. Boreal broadleaf stocking guidelines

BWBSmw1 and mw2, Prince George Forest Region

Site Series	Primary Species	Secondary Species	Tertiary Species[2] (specify MSSpa %)	TSSpa	MSSpa	MSSp	Minimum inter-tree distance (m)
01	At, Ac[1]		Ep,Sw (15%)	2500	2000	1700	1.4

Regeneration Date (yrs)	Early Free Growing Date (yrs)	Late Free Growing Date (yrs)	Minimum Free Growing Tree Height (m)	Crop Tree/ Brush Ratio	Maximum Density (countable sph)
4	5	10	2.0	N/A	N/A

[1] Ac acceptable if not sprouting from a cut stump.

[2] Acceptability criteria (minimum height, etc.) for secondary or tertiary species would be defined in the silviculture prescription.

Appendix 7. Interpretation of cautionary and restrictive codes used in species selection guidelines

This appendix provides interpretations for each of the footnotes used in the species selection tables of this guidebook.

Footnotes applied to species are intended to inform planners, practitioners, and others of the potential issues surrounding the selection of that species. Each of the footnotes is worded as briefly as possible and users of this guidebook should read this section to familiarize themselves with the ecology and intent behind each footnote.

Footnotes are listed briefly and by number at the end of this appendix.

Microsite limitations (Footnotes 1, 2, 28, 41, 52)

A microsite is a portion of a site that is uniform in microtopography and surface soil characteristics. Microsites can range in size from one to five m^2 and can change suddenly. Within a site series, some tree species may establish and grow well only on certain microsites.

1. elevated microsites are preferred

Planting on elevated microsites reduces the limitation posed by wet and/or cold soils. Elevated microsites tend to be drier and warm faster than non-elevated sites.

2. suitable on thick forest floors

Western hemlock (*Tsuga heterophylla*) is able to germinate on thick forest floors (>20 cm) and abundant decayed wood. On these sites, it has a comparative advantage over other species such as Sitka spruce and western redcedar.

28. limited by moisture deficit

Dry soils or high rates of moisture loss from the leaves of seedlings can result in poor growth or mortality. Site series where dry soils are common usually occur on shallow soils, coarse-textured soils and/or steep slopes. On these sites, planting on moister microsites such as pockets of deeper soil, slight depressions, and shaded areas reduces the limitation posed by dry soils.

41. limited by poorly drained soils

Survival and growth is limited by poorly drained soils. These soils are identified by having prominent mottling or low chromas (gleying) in the surface 30 cm.

52. restricted to sheltered microsites with deep soil

The species is acceptable only on sheltered microsites with deep pockets of soil. This footnote is used on site series where soil is typically shallow and can be exposed, such as on rock outcrops.

Mesosite restrictions (Footnotes 3, 4, 6–12, 25–27, 36, 42, 54, 55)

Within a site series, some species will be reasonably productive provided they grow on the appropriate mesosite (sometimes recognized in regional field guides as site series phases). Mesosites can be defined by site and soil differences between ecosystems belonging to the same site series. They can occur at scales of 0.01–0.50 ha and have a bearing on establishment and regeneration success.

3. restricted to coarse-textured soils

Coarse-textured soils are defined here as sand and loamy sand; or sandy loam, loam, sandy clay loam with >70% coarse fragments. Some species grow better on coarser textured, well-drained soils.

4. restricted to medium-textured soils

Medium-textured soils are defined here as sandy loam, loam, and sandy clay loam with <70% coarse fragments; silt loam and silt textures with >20% coarse fragments; and silty clay loam and clay loam textures with >35% coarse fragments. Medium-textured soils retain more moisture than the sandy, glaciofluvial soils that may also occur in the same site series.

6. suitable on nutrient-very-poor sites

Species suitable on these sites have a comparative advantage over species whose growth may be more limited by very poor nutrient levels. This applies to lodgepole pine, primarily on drier site series of CWH subzone/variants. Pine's ability to grow well on nutrient-very-poor sites makes it an alternative for Douglas-fir, which also occurs on these sites.

7. restricted to nutrient-medium sites

Species restricted to these sites are usually more sensitive to very poor or poor nutrient levels than other recommended species. Although these species have slightly higher nutrient requirements, they are acceptable alternatives and sometimes primary species on nutrient-medium examples of a site series that is typically very poor to poor.

8. restricted to steep slopes

Steep slopes are defined here as greater than approximately 35% in the interior or greater than 50% on the coast. Species restricted to these sites may be frost intolerant. Steep slopes—especially south-facing—have reduced frost hazards relative to gentler slopes.

9. restricted to southerly aspects

Southerly aspects are mainly SSE to WSW with slopes >25% in the interior or >35% on the coast. Species restricted to these sites may be frost intolerant and/or better adapted to drier soil conditions and lower humidity. South slopes with moderate to steep gradients have reduced frost hazards, relatively drier soil, and lower humidity than other aspects. In some cases, these conditions are also offered by crest slope positions.

10. restricted to northerly aspects

Northerly aspects are mainly NW to ENE with slopes >35% in the interior or >50% on the coast. Species restricted to these sites may be better adapted to cooler and wetter sites within the range of the site series. Species may also be susceptible to heat stress from high surface temperatures and north slopes are generally cooler and moister than south slopes so provide protection from heat stress.

11. restricted to crest slope positions

Species restricted to these sites may be frost intolerant. Crest slope positions have a reduced frost hazard, much like south aspects with moderate to steep gradients. In some cases, planting on moderate to steep south aspects offers similar site conditions as crest slope positions.

12. suitable on cold air drainage sites

Cold air drainage sites are areas susceptible to cold-air ponding and frost. Species suitable on these sites have a comparative advantage over species whose growth may be more limited by cold-air drainage.

25. suitable on sites lacking salal

Some species, such as Sitka spruce, exhibit very poor growth on salal-dominated sites. Competition from salal (*Gaultheria shallon*) can severely limit growth of trees by exploiting moisture and nutrients more quickly than seedlings and by shading them out.

26. suitable minor species on salal-dominated sites

These species are usually more sensitive to very poor or poor nutrient levels associated with salal-dominated sites than other recommended species. They may also have a comparative disadvantage to other species with respect to salal competition so should only be used as a minor component

27. partial canopy cover required for successful establishment

The most reliable regeneration option for species restricted to these sites is the establishment of natural regeneration under a partial canopy. Shading created by a partial canopy reduces evaporative losses from soil and seedling leaves, reduces the competitive advantage of shade-intolerant vegetation and reduces the frost hazard. This footnote is primarily applied to Douglas-fir ecosystems in very dry and dry climates.

36. suitable major species on salal-dominated sites

Some species have a comparative advantage over other species with respect to salal competition and low nutrient availability and should be used as a major species on salal-dominated sites.

42. restricted to fresh moisture regimes

The species will not be reasonably productive unless planted on soils with fresh actual soil moisture regime.

54. risk of unsuccessful release of advance regeneration

The species, although acceptable on these sites, is more suited to wetter sites. Moisture deficits may prevent successful release of advance regeneration.

55. acceptable in sx-sm portion of site series

The species is acceptable only on sites in the subxeric to submesic moisture range of the site series.

Geographic restrictions (Footnotes 13–24, 43, 44–46, 50, 53)

Geographic restrictions are noted when a species' range of occurrence does not encompass the entire biogeoclimatic unit and when experience has demonstrated that not all areas are suitable for the species. In these cases, a species may be restricted to the geographic area where it naturally occurs.

13. restricted to upper elevations of biogeoclimatic unit

Species restricted to these elevations may be better adapted to cooler sites than is typical for the subzone/variant. Sites at higher elevations tend to have cooler temperatures than sites at lower elevations in a given subzone/variant. An alternative to planting at higher elevations is to plant on north aspects (see footnote #10), which are also cooler than normal.

14. restricted to lower elevations of biogeoclimatic unit

Species restricted to these sites may be frost intolerant and/or better adapted to sites with warmer air temperatures. Sites at lower elevations tend to have warmer temperatures than sites at upper elevations in a given subzone/variant.

An alternative to planting at lower elevations is to plant on south aspects (see footnote #9), which are also warmer than normal.

The following latitudinal, longitudinal, and specific geographic restrictions are intended to confine the use of a species to its natural geographic range:

15. restricted to northern portion of biogeoclimatic unit in region

16. restricted to southern portion of biogeoclimatic unit in region

17. restricted to western portion of biogeoclimatic unit in region

18. restricted to eastern portion of biogeoclimatic unit in region

19. restricted, not in Queen Charlotte Islands

20. restricted, not near outer coast

21. restricted to mainland

22. restricted to southern Gardner Canal–Kitlope area

43. suitable on mainland coast only (QCI only)

44. suitable in areas with stronger maritime influence

45. suitable in areas with stronger continental influence

46. restricted to area north of the Dean Channel

23. restricted to trial use

Species extended beyond their normal geographic range should be used on a trial basis only.

24. suitable as major species in wetter portion of biogeoclimatic unit

The species is acceptable as a major component of the stand in the wetter portion of the biogeoclimatic unit and thus serves as an alternative to species that are usually a major component of the stand in all parts of the biogeoclimatic unit.

50. restricted to sites where the species occurs as a major species in a pre-harvest, natural stand

The species is approaching its geographic limit but the boundaries of its range are unclear. It is restricted to sites where it occurs naturally as a major species in a pre-harvest, natural stand. The species' distribution at this extreme of its range is typically spotty, occurring on sites that offer compensating effects for conditions present in its more typical range.

53. minor component

Species generally occurs as a minor component or subcanopy tree in natural stands.

Pest limitations (Footnotes 29–31, 35, 37, 47–49)

Species with specific pest-related footnotes in the tables are known to experience a high level of damage (e.g., white pine) compared to other species that occur on a site unit or within a subzone, and therefore may not be as reliable as other species for management.

29. risk of heavy browsing by moose

Moose (*Alces alces*) browse the terminal and lateral shoots of young conifer seedlings and sometimes uproot them. They pose a risk, primarily to subalpine fir in northern SBS and ICH ecosystems. Subalpine fir is usually managed as a minor component of the stand on these sites, secondary to pine and/or spruce.

30. risk of porcupine damage

Porcupines (*Erethizon dorsatum*) debark the upper bole and major branches of larger trees, injure the bark of saplings, and girdle the base of smaller trees. They pose a risk, primarily to western hemlock and Sitka spruce in the CWHvm1 and vm2 of Prince Rupert Forest Region (Kalum and North Coast forest districts). Western hemlock and Sitka spruce are usually managed as minor components of the stand on these sites, secondary to western redcedar and amabilis fir.

31. risk of white pine blister rust

White pine blister rust (*Cronartium ribicola*) is a stem rust that produces diamond-shaped cankers on western white pine (*Pinus monticola*). Stem infections are lethal but branch infections may be pruned if they are a safe distance from the stem. It poses a serious risk wherever white pine is found, especially where it grows in close proximity to currants and gooseberries (*Ribes* spp.), which are alternate hosts to the rust. Western white pine is usually managed as a minor component of the stand and rated as a tertiary species unless pruning is conducted.

35. risk of weevil damage

The spruce leader weevil (*Pissodes strobi*; also known as spruce weevil, Sitka spruce weevil, or white pine weevil) is an inner bark feeder that attacks the terminal shoots of spruce trees. Faster growing species can serve as a nurse crop (e.g., lodgepole pine, aspen, red alder, cottonwood) to reduce risk of attack on the leaders. For hybrid white spruce, elevation plays a critical role in determining susceptibility and local pest management specialists should be contacted for details.

37. risk of heart rots

Heart rots are caused by decay fungi and can result in growth loss, stem failure, and mortality. Common entry points for infections are wounds, dead branchlets, branch stubs, or other dead woody tissue. Almost all tree species in all ecosystems are susceptible to one or more common heart rots with, as a rough rule, thin barked, less resinous species (e.g., hardwoods, hemlock, true firs) being more prone to decay than thick barked, more resinous species (e.g., pines, Douglas-fir). The risk of heart rot will decline in stands managed as even-aged (using planted stock or seeded regen), and on shorter rotations (e.g., 80–100 years). The longer the trees will be retained, the greater the risk of decay losses.

47. risk of balsam woolly adelgid

The balsam woolly adelgid (*Adelges piceae*), accidentally introduced from Europe, feeds on the stems and branches of true firs causing calluses and gall-like formations. Continued feeding disrupts conductive tissue, interferes with the translocation of water and nutrients, and can cause extensive mortality. Its range is still expanding, but is most commonly found on the lower mainland, southern Vancouver Island (as far north as Campbell River on the east side), West Thurlow Island, the Sunshine Coast south of the Jervis Inlet, and probably as far inland as Merritt and Lillooet forest districts. In these areas, it poses a risk, primarily to amabilis fir, but as it expands into the interior, subalpine fir may be seriously impacted. Effects on grand fir (*Abies grandis*) can be significant as well.

48. risk of heavy browsing by deer

Black-tailed deer (*Odocoileus hemionus columbianus*) browse the terminal and lateral shoots of young conifer seedlings and sometimes uproot them. They pose a risk, primarily to western redcedar and yellow-cedar on the outer coast (CWHvh2) and on islands with no natural deer predators such as Texada and the Queen Charlotte Islands. Plantations of red alder (*Alnus rubra*) have also been heavily browsed on the Queen Charlotte Islands.

49. applies only to rust resistant, planted stock

White pine planting stock that has proven resistant (65–70% rust free after 13 years) to blister rust is available from the United States Forest Service Seed Orchard at Moscow, Idaho. Only this seed source is currently considered sufficiently “resistant” to allow the use of white pine. Use of the Moscow stock is restricted to the southern interior ICH, south of 52° latitude. It is not suitable for the coast.

Abiotic limitations (Footnotes 32, 34, 39, 40, 51)

32. limited by growing-season frosts

During the establishment phase, some tree species are highly susceptible to growing-season frosts, resulting in damage and mortality. On site series where growing-season frosts are common, the use of frost-tolerant species is recommended.

Possible remedies when using frost-susceptible species include maintaining a protective overstorey cover, improving air drainage, mixed-planting with fast-growing species (e.g., Pl, Acb) to provide some overstorey protection, and planting on elevated microsites to raise the seedling above the layer of most intense frost.

Relative tolerance to growing season frosts for the tree species of British Columbia included in these guidelines:

Relative tolerance to growing-season frost	Tree species
Very low	Cw, Dr, Fd, Hw, Mb
Low	Bg, Lw, Ss
Moderate	Ba, Bl, Pw, Py, Se, Sw, Sxs, Sx(w), Yc
High	At, Acb, Act, Ep, Hm, Lt, Pl, Pj, Pa, Sb

34. risk of snow damage

The use of a species may be restricted in a subzone or variant where the species has a high risk of *snow breakage* or damage resulting from snow press or snow creep. Snow breakage is most significant on species with ascending branching habits in areas of high snowfall or where wet snow is common. The use of provenance or progeny adapted to high snowfall may help ameliorate this problem.

Snow press may cause widespread damage to young tree seedlings, especially in plantations in high snowfall climates and sites with the greatest spring snow pack. Seedlings are damaged when leafy herbaceous plants are pressed downward onto them by the snow pack or when the snow pack itself breaks or tears lateral branches. The effects of snow press damage can be at least partially ameliorated by removing overtopping herbaceous vegetation from around the tree seedling and by planting species and stock types relatively resistant to snow press. Small diameter lodgepole pole stock is especially susceptible to snow press.

Snow creep occurs when the snow pack slides very slowly downhill and presses tree seedlings to the ground in the down-slope direction either directly or indirectly by pressing vegetation onto the seedling. Seedlings planted on the downhill side of barriers such as stumps are less affected by snow creep.

39. avoid exposed and windy sites

Growth and form are affected by persistent, strong winds. Buds on terminal shoots are abraded and foliage is lost under these conditions. This is primarily a concern for red alder on the outer coast.

40. risk of redheart

Redheart is a reddening of the "heartwood" of alder trees caused by a non-specific physiological response to fungal infections, frost cracks, and other stresses. It poses a risk primarily in submaritime climates where cold air outflows are common. The reddening devalues alder sawlogs considerably but does not affect their structural properties unless accompanied by a fungal heart rot.

51. restricted to areas with proven Pl performance

Lodgepole pine appears to be very susceptible to rusts, foliar pathogens, insects, and mammal damage at higher elevations and climatically wetter areas of the ICHmw2 and ICHmw3 of the Clearwater, Vernon, and Salmon Arm forest districts. Also, avoid higher elevation steep slopes with a history of snow damage. Pl should be restricted to geographic areas where it has a proven record and has formed mature stands containing a minimum volume of 15% Pl.

Broadleaf management (a, b)

Broadleaf species are valid regeneration options on many sites but are often limited in productivity, reliability, and/or feasibility. However, on some sites such as fluvial benches and floodplains, broadleaf management is often preferred.

a. productive, reliable, and feasible regeneration option

The species is not significantly limited in productivity, reliability, and feasibility and can be considered as a regeneration option within regional broadleaf management strategies.

b. limited in productivity, reliability, and/or feasibility

The species is capable of growing on the site but is not recommended as preferred because of its limitations in productivity, reliability, and/or feasibility. Alternatively, the species' regeneration performance may be unknown for the site. These sites are best managed for conifer species although broadleaves may be managed as minor components of the stand, especially where these species are managed to provide for non-timber values.

Cautionary and restrictive codes used in species selection guidelines

Number	Short description	Current examples of usage
1	elevated microsites are preferred	most hygric and some sub-hygric sites
2	suitable on thick forest floors	Hw in CWHvh2/05, 06, 07
3	restricted to coarse-textured soils	Fd in ICHvk2/01, 04
4	restricted to medium-textured soils	SbSx in SBPSdc/03a, 03b
5	Footnote retired	
6	suitable on nutrient-very-poor sites	Pl in CDFmm/01, 02
7	restricted to nutrient-medium sites	BaSs in CWHvh2/01
8	restricted to steep slopes	Fd in SBSmk1/07
9	restricted to southerly aspects	FdLwPy at northern limits of range
10	restricted to northerly aspects	BlSx in Kamloops and Nelson regions
11	restricted to crest slope positions	Fd in SBPSxc/02a, 02b, 02c
12	suitable on cold air drainage sites	Bl in CWHws2
13	restricted to upper elevations of biogeoclimatic unit	BlSx in Kamloops and Nelson regions
14	restricted to lower elevations of biogeoclimatic unit	CwSs in MHwh
15	restricted to northern portion of biogeoclimatic unit in region	Ss in IDFww, Fd in SBSmc1/01, 06, 07
16	restricted to southern portion of biogeoclimatic unit in region	Bl in MSxv, Hm in ESSFvv
17	restricted to western portion of biogeoclimatic unit in region	Fd in SBSwk1, Yc in MHmm2
18	restricted to eastern portion of biogeoclimatic unit in region	Fd in SBPSxc, LwSe in CWHms1
19	restricted, not in Queen Charlotte Islands	Ba in CWHvh2
20	restricted, not near outer coast	
21	restricted to mainland	
22	restricted to southern Gardner Canal-Kitlope area	Fd in CWHvm1, PR region only
23	restricted to trial use	Pl in ESSFwc2, Lw in Kamloops/Nelson ICH
24	suitable as major species in wetter portion of biogeoclimatic unit	Hw in CWHxm/01
25	suitable on sites lacking salal	PlSs in CWHwh1/04
26	suitable minor species on salal-dominated sites	Ba in CWHvm1
27	partial canopy cover required for successful establishment	Fd on various sites in IDF
28	limited by moisture deficit	BlSx on various dry site series in dry climates
29	risk of heavy browsing by moose	Bl in ICHmm
30	risk of porcupine damage	HwSs in CWHvm
31	risk of white pine blister rust	Pw on most sites
32	limited by growing-season frosts	many species, many sites
33	Footnote retired and replaced with footnote 'a'	
34	risk of snow damage	Pl in ESSF
35	risk of weevil damage	Ss in CWHvm
36	suitable major species on salal-dominated sites	Cw in CWHwh1/01
37	risk of heart rots	Cw in wetter units of ICH
38	Footnote retired	
39	avoid exposed and windy sites	alder on outer coast
a	productive, reliable, and feasible regeneration option	Act on floodplains
b	limited in productivity, reliability and/or feasibility	broadleaf maple in CWHvm1/01

Number	Short description	Current examples of usage
40	risk of redheart	alder in CWH
41	limited by poorly drained soils	alder in the CWH
42	restricted to fresh moisture regimes	broadleaves in the CWH
43	suitable on mainland coast only	Ba in MHwh, Vancouver Forest Region
44	suitable in areas with stronger maritime influence	Hw in MHmm2, Vancouver Forest Region
45	suitable in areas with stronger continental influence	Bl in MHmm2, Vancouver Forest Region
46	restricted to areas north of the Dean Channel	Ss in CWHms2/05, Vancouver Forest Region (single use)
47	risk of balsam woolly adelgid	Ba in CWHmm1/07, Vancouver Forest Region (single use)
48	risk of heavy browsing by deer	Cw and Yc in the CWHvh2 of Prince Rupert Forest Region
49	applies only to rust resistant, planted stock	all Pw in southern interior ICH
50	restricted to sites where the species occurs as a major species in a pre-harvest, natural stand	newly added tertiary species approaching geographic limit in Cariboo Forest Region
51	restricted to areas with proven Pl performance	
52	restricted to sheltered microsites with deep soil	Fd and Pl on some rocky sites in Kamloops Forest Region
53	minor component	newly added tertiary species in Prince Rupert Forest Region
54	risk of unsuccessful release of advance regeneration	Bl on very dry sites in Nelson Forest Region
55	acceptable in sx-sm portion of site series	Cw in ESSFwc1/02 in Nelson Forest Region (single use)

Appendix 8. Forest stand structures

Forest stands can be visualized as three general structural types:

- even-aged, non-stratified canopy stand structures of single or mixed-species stands
- even-aged, stratified canopy stand structures of mixed-species stands
- uneven-aged, multi-storied stand structures of single or mixed-species stands.

This section is based upon the principles outlined in Klinka *et al.* 1984, and in Klinka and Carter 1990. These principles have been modified only to reflect the provincial scope of these guidelines.

This analysis of stand structure is done mostly from the perspective of having sawlog production as the primary management objective. Higher level plans may require analysis of these forest structures from other perspectives (forage, wildlife, recreation, conservation and other natural resource values).

Even-aged, single canopy, single crop species

This stand structure is best suited to harsh environments where relatively few species options are available.

For example, on very dry, nutrient-very-poor sites, where both lodgepole pine and Douglas-fir are ecologically suitable, lodgepole pine has a much faster initial growth rate than does Douglas-fir, and will become merchantable at a much earlier age. Consequently, on a short rotation, a mixture of the two species would be less productive than a pure lodgepole pine stand.

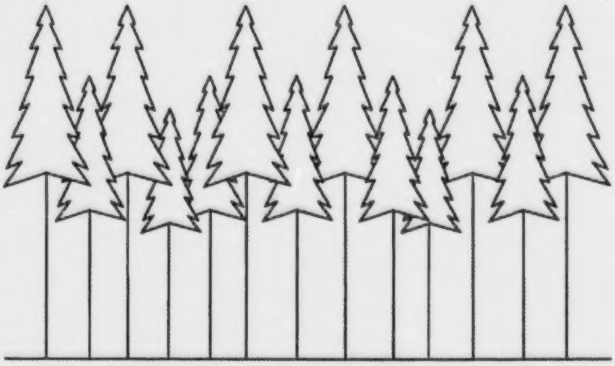


Figure A8-1. The structure of a single canopy, mature, even-aged, single crop species stand, showing relative positions of the dominant and codominant crown classes.

Even-aged, single canopy, two crop species

This stand structure is best suited to those tree species that have very similar growth rates, shade tolerance, and natural pruning.

If species with differing growth rates are intimately intermingled, these non-stratified single-canopy mixtures may be less productive than pure stands of any one of the component species. In such mixtures, the production potential of the fastest-growing species may be diluted by the less-productive species. As well, the species with the most rapid juvenile growth may attain dominance, and the slower-growth species may lapse into the understorey. If not sufficiently shade-tolerant, the slower-growth species will suffer suppression and may not become a useful size within the intended rotation.

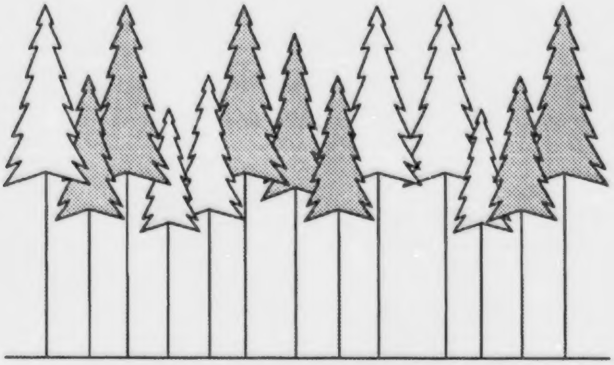


Figure A8-2. The structure of a single canopy, mature, even-aged, two crop species stand. This stand structure is applicable only to those species that grow at similar rates and have similar tolerances to shade (e.g., Fd-Se mixtures in the CWH ms1 variant).

Even-aged, double canopy, mixed stands of a minor, less shade-tolerant crop species and a major, more shade-tolerant crop species

In this stand structure, the uppermost stratum consists of scattered emergents above the general canopy. These dominant trees will continue to grow in diameter for a long time because their crowns will remain deep and exposed to light. The trees of the lower strata may act as trainers, causing some continued natural pruning. This stand structure could be a useful method of growing a highly valuable species such as white pine that has a high pest risk (blister rust).

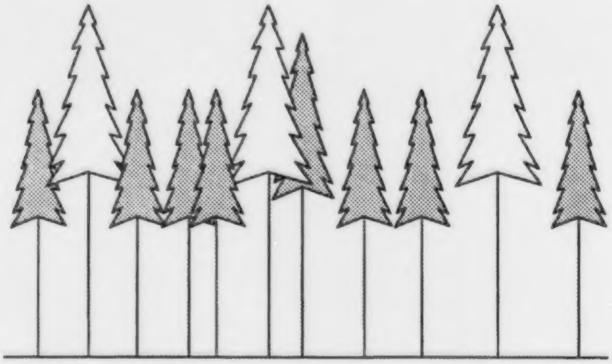


Figure A8-3. The structure of a double-canopy, mature, even-aged stand, composed of a minor, less shade-tolerant crop species and a major, more shade-tolerant crop species. This sketch approximates Pw-Fd or Py-Fd mixtures.

Even-aged, double canopy, mixed stands of a major, less shade-tolerant crop species and a major, more shade-tolerant crop species

Stratified double canopy mixtures of compatible species (compatible primarily due to light requirements) are likely to be more productive than pure stands of any one species. Establishment of an even-aged stand consisting of a shade-intolerant species in the upper layer with one or two shade-tolerant species in the lower layer will result in maximum use of the above- and below-ground growing space, and in turn will maximize volume production.

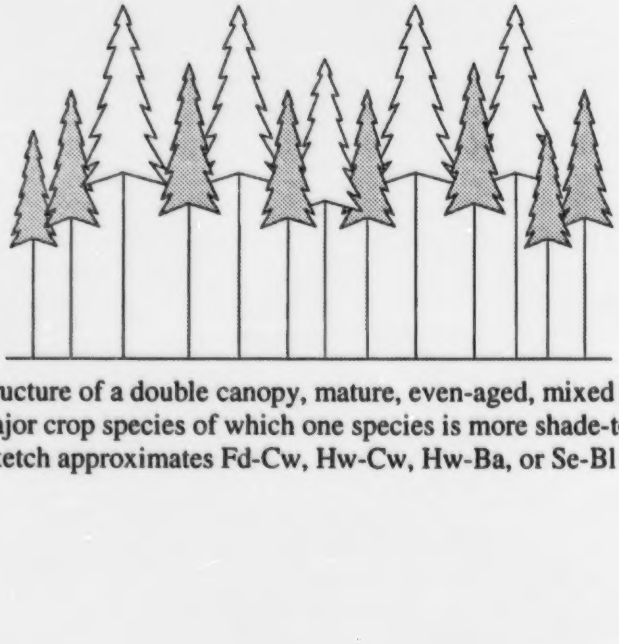


Figure A8-4. The structure of a double canopy, mature, even-aged, mixed stand, composed of two major crop species of which one species is more shade-tolerant than the other. This sketch approximates Fd-Cw, Hw-Cw, Hw-Ba, or Se-Bl mixtures.

Even-aged, multiple canopy, mixed stands of several major crop species

This stand structure is most suited to sites where soil conditions (moisture and nutrients) and the climate favour the productive growth of several tree species. These stands comprise multiple layers of several crop species, each with different tolerances to shade. The tree species in these stands are usually arranged with the intolerant species in the upper layer and species of increasing tolerance in successive layers.

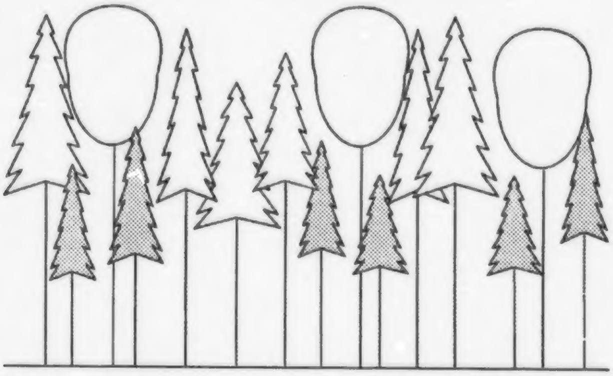


Figure A8-5. The structure of a multiple canopy, mature, even-aged, mixed stand composed of three crop species. This sketch approximates an Act-Ba-Cw mixture, which is an option for active alluvial floodplains in the CWHdm subzone.

Uneven-aged, multi-storied stand structures

The most complex of all the stand structures is the uneven-aged, multi-storied stand structure. This form of stand is commonly irregular, consisting of a variety of age classes and sizes. The most common type of uneven-aged structure is a multi-aged stand (in contrast to an all-aged stand) of two or more age classes. These stand structures range from the rather simple two-storied, uneven-aged stands (Figure A8-6), which often form from single-storied, even-aged stands in the advanced stages of secondary succession, to the more complex multi-storied, uneven-aged stands (Figure A8-7).

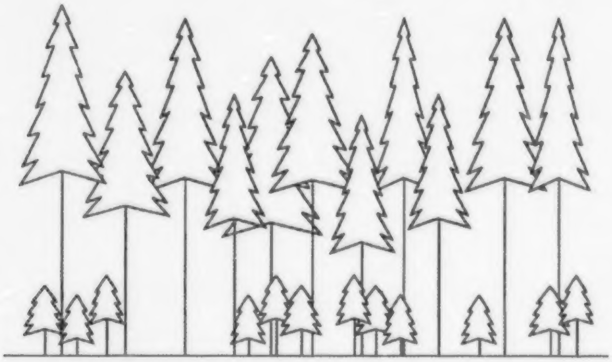


Figure A8-6. Uneven-aged, two-storied stand structure. The lower stratum is usually a shade-tolerant species that has seeded during the late stages of secondary succession. This sketch approximates an Sw-Bl mixture.

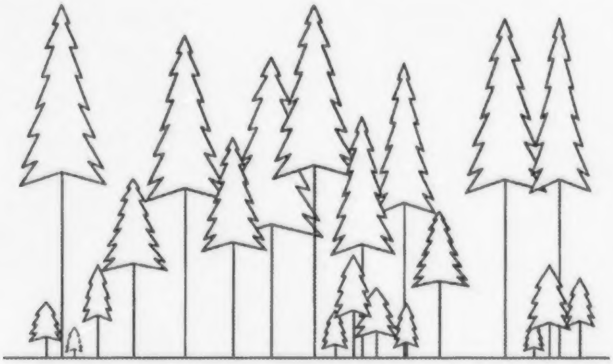


Figure A8-7. Uneven-aged, multi-storied stand structure. This sketch approximates an uneven-aged interior Douglas-fir stand characteristic of the interior Douglas-fir zone.

Uneven-aged stands, unlike even-aged stands, are harvested by selection methods and almost always regenerate naturally. In these stands, the post-harvest stand structures and species composition depend on the pre-harvest stand condition. The future stand structure and species composition are determined by regulating which trees are to be left after harvest. The residual stand not only makes up part of the future stand structure but also provides a seed source for natural regeneration. As well, the species composition can be shifted in younger age classes to shade-intolerant or shade-tolerant species, whichever is desirable, by keeping the overstorey thin or allowing it to grow dense.

Appendix 9. Free from brush – free growing criteria

Background

Free growing surveys are used to assess fulfillment of a silviculture prescription (SP) holder's reforestation obligations. To achieve this, the surveys describe the number of trees on an opening that meet the free growing guidelines.

There will be two possible methods for evaluating free growing. First, silviculture prescription holders can choose to use the free growing requirements in their approved SPs. Alternatively, the free growing guidelines described below can be the basis for assessing fulfillment of free growing obligations.

Free growing criteria

Each free growing tree must be:

- a preferred or acceptable species as outlined in the SP
- well-spaced as outlined in the SP
- free from damaging forest health agent incidences as defined in the free growing damage criteria
- free from unacceptable damage as defined in the advance regeneration acceptability criteria
- the required minimum height specified in the SP or, for SPs without a specified minimum height, must meet the minimum height requirement specified in the *Establishment to Free Growing Guidebook* for the species and site series
- free from unacceptable brush and broadleaf tree competition as described below. Acceptable levels of competition will vary depending on the type of vegetation (broadleaf tree or non-broadleaf tree) that is found within the effective growing space of the crop tree. The effective growing space of a crop tree is defined as a 1 m radius cylinder centred around the tree. A summary of the generalized free growing criteria described above, is provided in Figure A9-1.

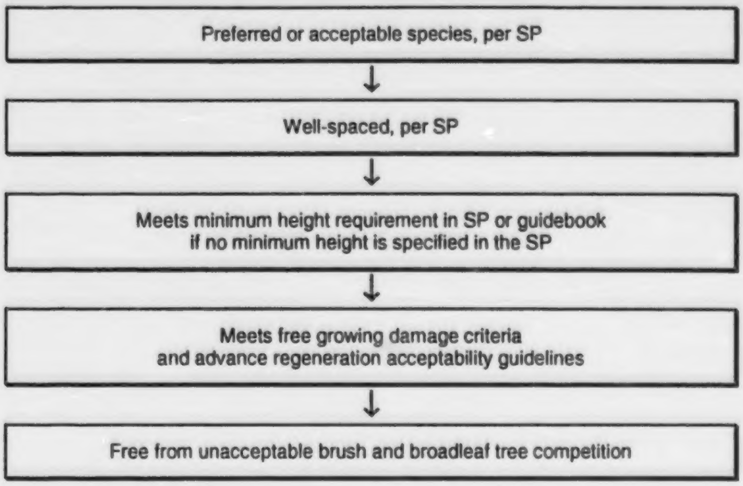

Preferred or acceptable species, per SP
Well-spaced, per SP
Meets minimum height requirement in SP or guidebook if no minimum height is specified in the SP
Meets free growing damage criteria and advance regeneration acceptability guidelines
Free from unacceptable brush and broadleaf tree competition

Figure A9-1. Free growing criteria.

Methods for evaluating free growing acceptability

Acceptable levels of brush and broadleaf tree competition

A free growing stand as defined in the *Forest Practices Code of British Columbia Act* is a stand of healthy trees of a commercially valuable species, the growth of which is not impeded by competition from plants, shrubs, or other trees. The concept of free growing was introduced to ensure that once adequate stocking and survival had been attained, productivity would be maintained.

The intent of the free growing concept is to identify and classify those areas of provincial forest land that have satisfactorily regenerated and reached a point where they are not being impeded by brush and can reasonably be expected to continue development to maturity without significant additional intervention. At this stage, liability and responsibility for free growing stands reverts from the licensee to the Crown.

The free growing guideline is not a competition index. Rather, it is a desired state for the free growing crop, which represents an “acceptable” level of risk to the Crown.

The risk that future treatments will be required varies with the type of vegetation and the maturity of the crop tree. For this reason, acceptable levels of vegetation within the effective growing space of a crop tree will be evaluated, in each free growing survey plot, under the following three broad categories:

1. vegetation communities without broadleaf tree competition

2. vegetation communities that include aspen, birch, and upland cottonwood (cottonwood with the same form as aspen)
3. vegetation communities with red alder, bigleaf maple, and cottonwood (with coastal form).

All brush and broadleaf tree vegetation found within the 1 m radius effective growing space of a crop tree must be considered when assessing levels of competition. This includes brush and broadleaf tree vegetation originating inside and outside of the 1 m radius cylinder.

Acceptable levels of vegetation in the CWH and CDF zones and in the IDFww subzone are evaluated differently from other biogeoclimatic subzones. Assessment procedures for these areas are discussed in the section "Assessing vegetation in the CWH and CDF zones and IDFww subzone."

Methods for evaluating acceptable levels of vegetation include a quadrant system and allowable numbers of countable broadleaf trees for aspen, birch, and upland cottonwood. Detailed information on evaluation methods is provided in the section "How to assess free growing trees."

Assessing vegetation communities without broadleaf tree competition

Non-broadleaf tree vegetation includes all other types of vegetation including herbaceous/low shrub and tall woody shrub species (e.g., fireweed and willow). To be free growing, the crop tree must be taller than the non-broadleaf tree vegetation in at least three quadrants of its effective growing space (1 m radius cylinder). Non-broadleaf tree vegetation will commonly be referred to as "other vegetation" in this document (Figure A9-2).

Retention of certain herbaceous or shrub species, at levels that exceed the guidelines, may be considered beneficial for a given site. These species would not be considered competitors under specific circumstances. For example, a dry alder complex in the site series IDFdk3 01 has Sitka alder cover estimated to be 15% and conifers are growing well and have good height and diameter increment. The cautionary and restrictive notes for the IDF dk3 01 indicate management strategies should provide planted seedlings and natural regeneration with shade and protection from frost damage. In this case, well-spaced, healthy crop trees that have reached the minimum height may be considered free growing if taller Sitka alder exists in more than one quadrant.

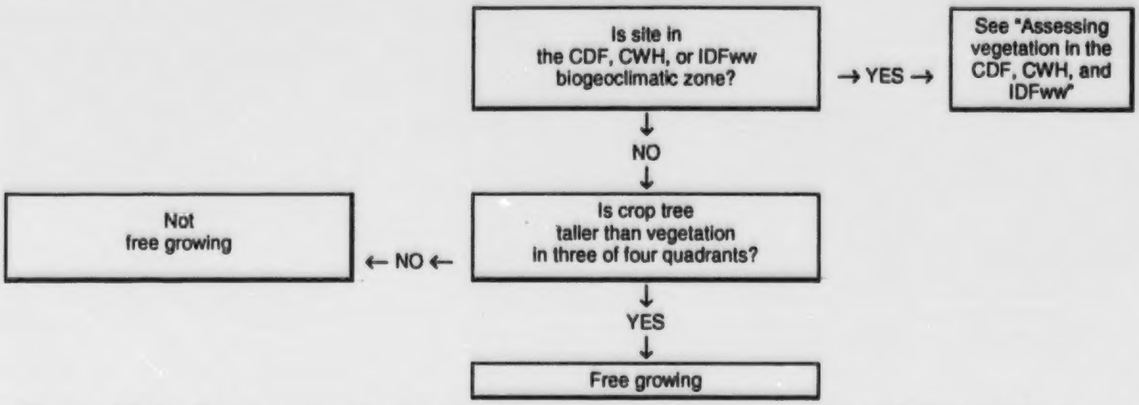

Is site in the CDF, CWH, or IDFww biogeoclimatic zone?
→ YES →
See "Assessing vegetation in the CDF, CWH, and IDFww"
NO
Is crop tree taller than vegetation in three of four quadrants?
← NO ←
Not free growing
YES
Free growing

Figure A9-2. Free growing decision matrix for vegetation communities without broadleaf tree competition.

Assessing vegetation communities that include broadleaf tree competition*

In vegetation communities that include broadleaf trees, a crop tree is considered free growing if:

- The crop tree is at least the required height above the broadleaf tree or other vegetation. The required height is expressed as a percent (150% or 125%) of the brush height (as stated in the SP). A conifer to brush ratio of 150% or 125% means that the tree must be 50% or 25% taller, respectively, than the height of the broadleaf tree or other vegetation that is within the effective growing space.

The next section provides an opportunity to count some crop trees as free growing where the crop tree is less than the required height above the broadleaf tree or other vegetation.

Assessing vegetation communities that include aspen, birch, and upland cottonwood

For the purpose of this section, upland cottonwood refers to cottonwood that has the same general form as aspen. It is expected that cottonwood will be assessed in this fashion on most interior sites. Where cottonwood growth is very aggressive (e.g., on productive coastal ecosystems, alluvial flood plains, or other rich sites), it is recommended that cottonwood be treated in a similar fashion to red alder and bigleaf maple (see "Assessing vegetation communities with red alder, bigleaf maple, and cottonwood"). District managers will provide direction on how cottonwood will be assessed in their district.

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* Direction or assessment procedures for species such as 'pin cherry' which are not logically classified as a tall woody shrub, will be required from the district.

In communities that include aspen, birch, and upland cottonwood, a crop tree may not meet free growing requirements due to broadleaf trees, other vegetation or a combination of the two. For example, a crop tree is not free growing if broadleaf trees, other vegetation, or any combination of broadleaf trees and other vegetation are taller than the crop tree in two or more quadrants. If a crop tree is overtopped in only one quadrant (or not overtopped in any quadrant), the crop tree meets the free growing standard for vegetation other than broadleaf trees.

A crop tree that is not the required height above aspen, birch, and upland cottonwood (not 150% or 125% the height of the broadleaf tree) but is taller than the broadleaf tree and other vegetation in three of the four quadrants *can* be considered free growing if:

- the number of countable aspen, birch, and upland cottonwood trees is within the prescribed threshold limits (Figure A9-3). (See the section "How to assess free growing trees" for detail on countable stems, and Table A9-2 for allowable number of broadleaf trees).

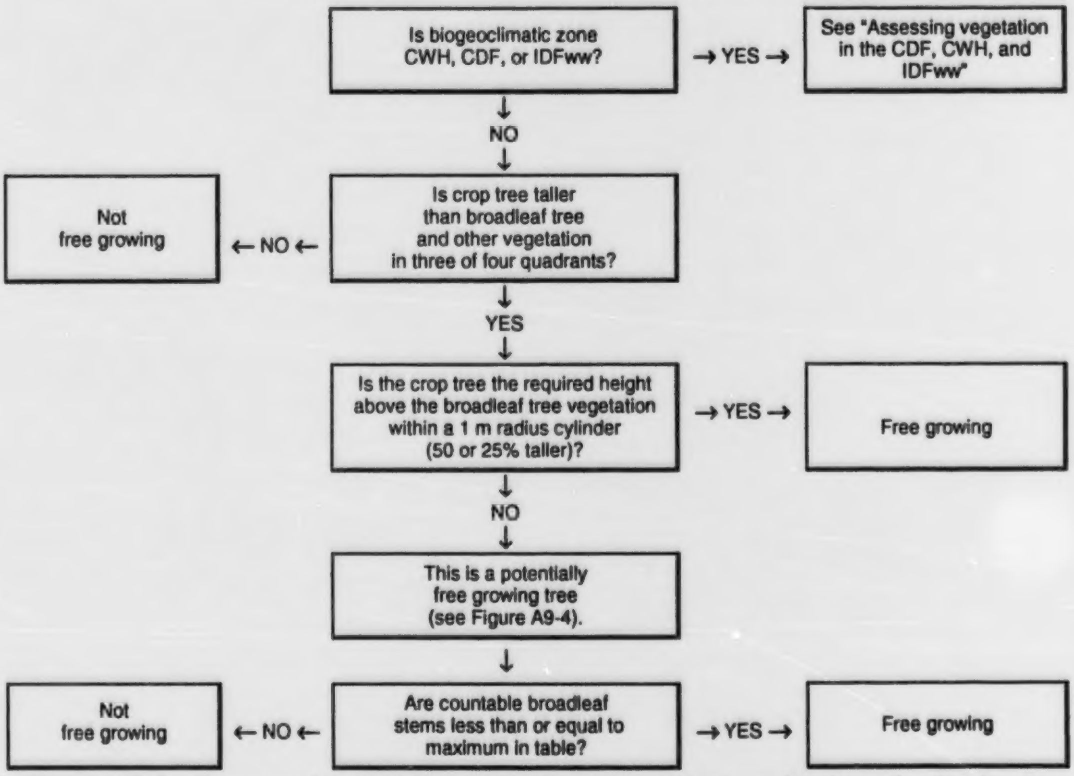
Is biogeoclimatic zone CWH, CDF, or IDFww?
→ YES →
See "Assessing vegetation in the CDF, CWH, and IDFww"
NO
Is crop tree taller than broadleaf tree and other vegetation in three of four quadrants?
← NO ←
Not free growing
YES
Is the crop tree the required height above the broadleaf tree vegetation within a 1 m radius cylinder (50 or 25% taller)?
→ YES →
Free growing
NO
This is a potentially free growing tree (see Figure A9-4).
Are countable broadleaf stems less than or equal to maximum in table?
← NO ←
Not free growing
→ YES →
Free growing

Figure A9-3. Free growing decision matrix for areas with aspen, birch, and upland cottonwood.

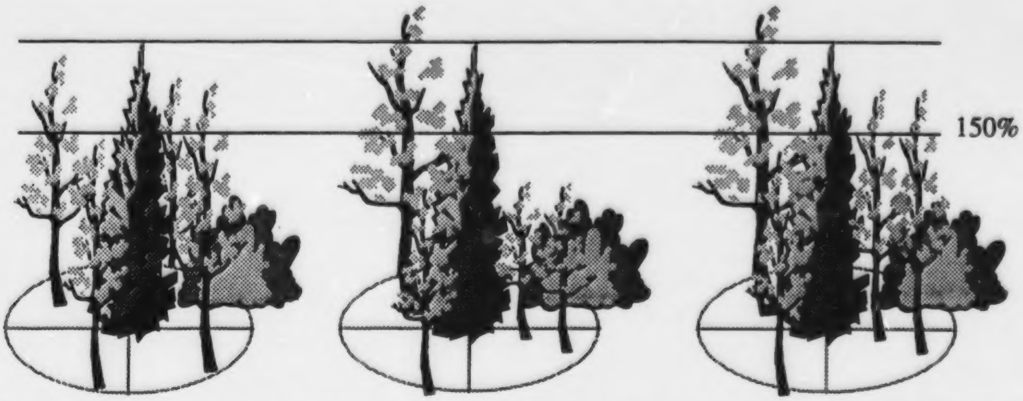

Figure A9-4. Potentially free growing trees. Left: Crop tree is not the required height above the broadleaf trees. Centre and right: Crop tree is taller than broadleaf tree and other competition in three of four quadrants.

Assessing vegetation communities with red alder, bigleaf maple, and cottonwood

For these broadleaf tree species a crop tree is considered free growing if the crop tree is at least the required height (50% or 25%) above any broadleaf tree vegetation within a 1 m radius cylinder as required by the SP. If this requirement is not met, the crop tree is not free growing (Figure A9-5). Guidelines regarding numbers of 'countable' broadleaf trees (3.99 m plot) do not apply to these species. For a crop tree to be free growing, it must also meet the free growing requirements for other vegetation as presented in Figure A9-5 below.

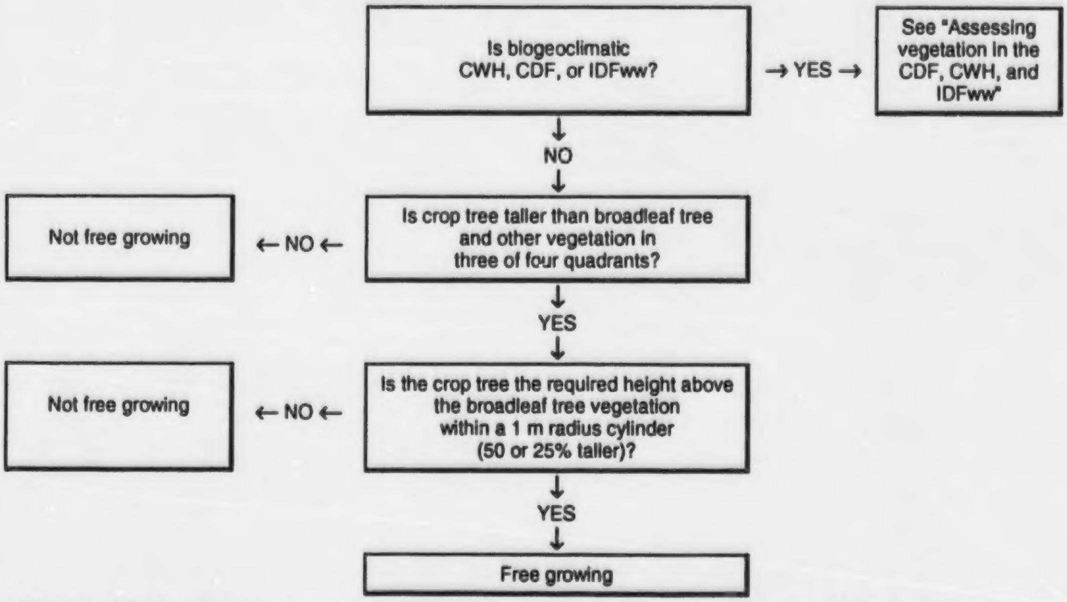
Is biogeoclimatic CWH, CDF, or IDFww?
→ YES →
See "Assessing vegetation in the CDF, CWH, and IDFww"
NO
Is crop tree taller than broadleaf tree and other vegetation in three of four quadrants?
← NO ←
Not free growing
YES
Is the crop tree the required height above the broadleaf tree vegetation within a 1 m radius cylinder (50 or 25% taller)?
← NO ←
Not free growing
YES
Free growing

Figure A9-5. Assessment procedures for crop trees growing in association with red alder, bigleaf maple, and cottonwood.

Assessing vegetation in the CDF and CWH zones and in the IDFww subzone

In the CDF and CWH zones and in the IDFww subzone, a crop tree is considered free growing if the crop tree is at least the required height above broadleaf tree and other vegetation. The required height is expressed as a percent (150%) of the brush height within the effective growing space, as required by the SP (Figure A9-6). If this requirement is not met, the crop tree is not free growing. Districts may vary from this guideline on a site-specific basis.

Minimum heights are not a requirement, unless contained in the SP.

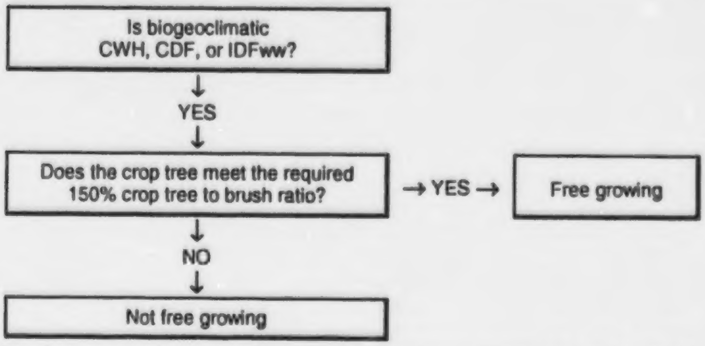
Is biogeoclimatic CWH, CDF, or IDFww?
YES
Does the crop tree meet the required 150% crop tree to brush ratio?
→ YES →
Free growing
NO
Not free growing

Figure A9-6. Assessment procedures for crop trees growing in the CWH or CDF zones and the IDFww subzone.

How to assess free growing trees

Three methodologies that will be used to determine whether a crop tree is free growing or not free growing are explained below:

- the quadrant method
- countable broadleaf trees
- allowable number of countable broadleaf trees.

The quadrant method

The quadrant method is used to determine whether a crop tree in the immediate vicinity of non-broadleaf tree vegetation is free growing. It is also used to determine whether a crop tree in the immediate vicinity of broadleaf tree vegetation is potentially free growing. The following three steps describe the quadrant method.

1. Divide the 1 m radius cylinder around the crop tree into four equal quadrants

2. Align the quadrants to minimize the number of quadrants that contain vegetation taller than the crop tree (including vegetation originating inside and outside the cylinder)
3. Determine whether the number of quadrants containing vegetation taller than the crop tree exceeds one quadrant (i.e., the tree is not free growing). Quadrants can not be split or divided (see Figure A9-7).

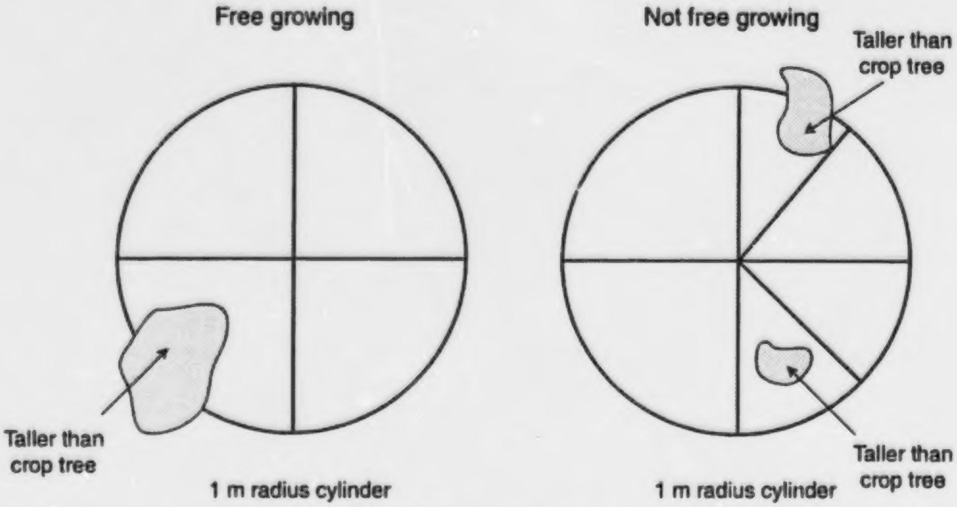

Figure A9-7. Assessing free growing using the quadrant method. The cylinder on the left illustrates one quadrant with vegetation taller than the crop tree. The cylinder on the right shows two quadrants with vegetation taller than the crop tree.

Countable aspen, birch, and upland cottonwood trees

Countable aspen, birch, and upland cottonwood trees will be assessed in the 50 m^2 (3.99 m radius) free growing survey plot. All aspen, birch, and upland cottonwood trees greater than the median height of all the potentially free growing trees will be considered countable broadleaf trees. When the heights of all the potentially free growing trees are placed in order from shortest to tallest, the median height is the middle height, or the mean of the two middle values where there is no one middle height. A potentially free growing tree is a crop tree that is not the required height above the aspen, birch, and/or upland cottonwood within the 1 m effective growing space, but is taller than the aspen, birch, and upland cottonwood in at least three of four quadrants (see Figure A9-4).

Where the early free growing date is advanced, or where other factors indicate that the median height of the potentially free growing trees does not adequately reflect the risk associated with the growth potential of the broadleaf trees, it is recommended that the district manager set a height limit for countable broadleaf trees.

Broadleaf tree clumps

The crown area of multiple stemmed broadleaf trees is larger than that of single-stemmed individuals. However, the total crown area and competitive effects of a multiple stemmed tree are often not as large as would be encountered with the same number of single-stemmed trees.

While numerous birch stems will often originate from one stump, aspen is more likely to sucker from below the ground or at the root collar (see Figure A9-8). Table A9-1 shows the relationship between the actual number of birch stems originating from a cut stump and the related number of countable broadleaf trees used during a free growing assessment. For aspen and cottonwood, and for birch that originate from below the ground level, all stems greater than the median height of the potentially free growing trees will be tallied as countable stems.

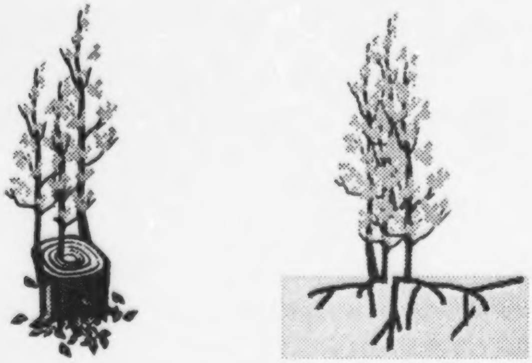

Figure A9-8. Numerous broadleaf stems originating from a stump and from below ground root suckers. Left: Three stems originating from a birch stump would be tallied as two countable trees. Right: Three aspen stems originating from below ground aspen root suckers are tallied as three countable trees.

Table A9-1. Comparison of multi-stemmed birch to numbers of countable birch trees.

Number of birch stems	Number to count
1	1
2–5	2
6 +	3

Allowable number of countable broadleaf trees

As broadleaf tree density increases, the reduced light availability may lead to a decrease in coniferous growth rates. However, coniferous growth can also be limited by other factors (e.g., presence and incidence of pests or diseases). Deviations from these guidelines may be necessary when other limiting factors are present. The allowable number of broadleaf trees will be assessed using a 50 m^2 (3.99 m radius) plot.

Aspen, birch, and upland cottonwood trees

All aspen, birch, and upland cottonwood that exceed the countable broadleaf tree height will be tallied. The number of countable trees in the plot will be compared to the allowable number of aspen, birch, and upland cottonwood trees shown in Table A9-2.

When a plot contains more than the allowable aspen, birch, or cottonwood trees for a given species and biogeoclimatic subzone/site series, only the potentially free growing trees of that species will become not free growing. A crop tree that meets the required SP crop tree-to-brush ratio (and all other free growing criteria) is free growing regardless of the number of broadleaf trees in the 50 m^2 plot.

For example, a plot in the ICHmk3 contains one potentially free growing lodgepole pine, one potentially free growing spruce, two free growing Douglas-fir, and four countable aspen. Only the potentially free growing pine will not be free growing (four countable trees exceed the limit of two for lodgepole pine), while the other three crop trees, including the spruce (four countable trees does not exceed the limit of five for spruce), are free growing. If the same plot was located in the IDFdk3 05 (submesic), the allowable number of countable broadleaf trees for lodgepole pine increases from two to five trees, therefore, all potentially free growing trees, including the lodgepole pine, are free growing.

Table A9-2. Allowable numbers of aspen, birch, and upland cottonwood trees[a]

Crop tree species	Biogeoclimatic subzone/site series	Allowable countable broadleaf trees per 50 m^2 plot
Pl, Py, Lw	IDFdk1, 2, 3, 4, – mesic and drier	5
	MSxv, SBPSdc, mk,	5
	SBSdw1, 2 subxeric and drier	5
	all other	2
Fdi, Pw, Pa	all	3
Sw, Se, Sb, Sx	BWBSmw1 (01, 03, 05, 06, 07), mw2 (01, 05, 06)	2 At, Act; 5 Ep
	all other	5
All other	all	5

[a] When a survey unit contains more than one subzone or site series, use the lower countable broadleaf limit.

Free growing surveys are carried out five to 20 years after commencement of harvesting. When surveys are conducted shortly after year five, conifers can be growing at an acceptable rate with broadleaf densities higher than those listed in Table A9-2. However, the allowable numbers of countable broadleaf trees must consider the development of these stands after year 20. The numbers in Table A9-2 reduce the risk that broadleaf trees will, subsequent to free growing being achieved, dominate the site.

Other broadleaf tree species

Crop trees in the other broadleaf tree complexes including red alder, bigleaf maple, and cottonwood (not upland), will be assessed using the pre-1999 guidelines and survey methodology (i.e., all crop trees must meet the required 125% or 150% crop tree to brush ratio). While the pre-1999 system does not allow for any of these broadleaf tree species within the 1 m radius circle of the crop tree, it is recognized that these species are beneficial at certain densities. Districts may set maximums for these species. However, using the methodology (3.99 m radius plot) to determine countable stems would not be effective because this plot size is too small to reflect densities that may be appropriate on some sites (i.e., each tree in the 3.99 m plot represents 200 trees/ha).

Appendix 10. Advance regeneration

Free growing acceptability guidelines for advance regeneration and residual mature and pole layer crop trees

In assessing advance regeneration and residual mature/pole layer crop trees, consider the following factors in preparing a silviculture prescription:

- Number of trees/ha: if advance regeneration is to be solely relied upon to restock a cutover, sufficient numbers must be present before harvest to compensate for logging and post-logging losses. A manageable stand of advance regeneration should contain total stem densities of at least twice the target stocking level to compensate for these losses.
- Tree quality: future crop trees should have good form and a healthy, vigorous appearance (i.e., good needle colour and length, no unacceptable pest damage or indicators, no major sweeps, and roots in acceptable medium). See Table A10-1, Table A10-2, and Appendix 5, "Free growing damage criteria for British Columbia."
- Tree height: the risk of windthrow of advance regeneration is often correlated with tree height. For example, in northern British Columbia following the removal of overstorey aspen, the risk of windthrow of understorey spruce has been found to increase dramatically for tree heights greater than 7 m.
- Height increment: Generally, trees growing well before harvest will respond well after harvest. Good post-harvest height increment is desirable, however, periodic reduced annual height growth may be acceptable when attributed to an external environmental factor (e.g., drought). Therefore, it is not always necessary that current year leader length exceed the previous year leader length.
- Age: With some species, pathological risk increases significantly with age or size. This is a feature mainly of shade-tolerant species such as Ba, Bl, Cw, Hw, or Yc. In addition, older trees may not respond as well as younger trees.
- IRM: Stems may be retained for wildlife habitat or other IRM purposes.

Site-specific factors may require that additional criteria for advance regeneration be specified in the silviculture prescription.

Table A10-1 outlines the free growing acceptability guidelines for layer three and four trees, while Table A10-2 outlines the free growing acceptability guidelines for layer one and two trees.

Table A10-1. Free growing acceptability guidelines for layer three and four advance regeneration

Species*	**Ba, Bl,**	**Cw**, Hm, Yc**	**Hw**		**Sx, Se, Sw**	**Fdi, Lw**	**Pa, Pli, Py**
BEC Zones	All***	CWH, CDF, MH, ICH	CWH, CDF, MH, ICH (Pr.Rup.)	ICH (other regions)	All*** (except BWBS)	All***	All***
Height at time of release	No height limit			<0.5m	No height limit		
Scars and damage	All species: No open (unhealed) injuries; no closed (healed) injuries with a horizontal width at the widest point(s), which is greater than 25% of the circumference of the tree at that point; no closed injuries that exceed 10% of the total length of the stem; no stem infection caused by a stem rust or dwarf mistletoe; no other externally visible pathological indicators including broken top, frost crack, conk, extreme basal sweep or unacceptable forks and crooks (see free growing damage criteria in Appendix 5 for description of unacceptable forks and crooks)						
Continuous live crown	All species: An acceptable tree has greater than 30% continuous live crown. Continuous live crown is the length of continuous green foliage on a tree expressed as a percentage of its total height. Continuous live crown refers to foliage on adjacent live green branches that forms the main part of the crown of a tree and extends over at least half of the circumference of the tree.						
Vigour	All species: Evidence of release (i.e., generally good post-harvest height increment) – Increased leader growth is not a requirement for trees in layer three and four in partial cut situations with low basal area removal where the trees remain heavily shaded by layer one and two trees.						

* For those species not listed here, the normal free growing acceptability criteria apply.
At regeneration delay, consider whether naturals will meet these criteria by free growing.
If western white pine (Pw) is to be considered, consult the *Pine Stem Rust Management Guidebook.*

** Beware of sun scald. If advance regeneration western redcedar is to be used, check for incidence of heart rot.

*** All refers to zones where these species are acceptable.

For additional information regarding decay fungi and advance regeneration refer to the *Tree Wounding and Decay Guidebook.*

Table A10-2. Acceptability guidelines for residual mature and pole layer crop trees

Scars and Damage	The impact that decay fungi have on residual trees depends largely on the retention period for the trees left behind. The management objectives determine how decay fungi should be managed. The *Tree Wounding and Decay Guidebook* provides recommended damage criteria by management regime. A tree is not acceptable as a residual crop tree if it meets or exceeds the applicable level of damage as determined by the stand management regime defined in Table 4 of the *Tree Wounding and Decay Guidebook.*
Continuous Live Crown	An acceptable tree should generally have greater than 30% continuous live crown. However, for trees greater than 17.5 cm dbh (>12.5 cm dbh for Pli), greater than 20% live crown will be acceptable.
Vigour	Evidence of release.
Other Considerations	Destructive sampling of a few stems is encouraged to ensure that most of the retained stems are sound. This is critical when heart rot susceptible species are retained as pole/mature residual crop trees and are listed as *preferred* in the SP.

Other survey criteria

Where advance regeneration or trees that vary from free growing survey criteria presented in the *Establishment to Free Growing Guidebooks* are expected to contribute toward stocking at free growing assessment, the criteria for acceptability should be stated with the stocking standards.

For more information on acceptability of advance regeneration and prescription development, see the *Silviculture Prescription Guidebook* and the *Silvicultural Systems Guidebook.*

Appendix 11. Guidelines for integrating grizzly bear habitat and silviculture in the coastal western hemlock biogeoclimatic zone

Overview

One of the key elements of British Columbia's Grizzly Bear Conservation Strategy, announced by government in June 1995, is a set of guidelines under the Forest Practices Code for mitigating the impacts of forest development and silviculture treatments. The release of the Identified Wildlife Management Strategy (IWMS) in 1999 was a major step towards conserving and managing critical grizzly bear habitats. Foraging wildlife habitat areas (WHAs) were defined in the IWMS to help ensure foraging opportunities in landscape units that have had extensive low elevation forest development and where there is limited forage supply outside of the timber harvesting land base (THLB).

One of the prescriptions for foraging WHAs is the reduction of regional stocking standards, either through alternative seedling spacing at planting or the spacing of an established stand to a cluster/gap arrangement. The IWMS will address this forage requirement in critical situations through focused application in threatened grizzly bear population (TGBP) units.

However, the IWMS is limited in its application. An alternative approach to address stable forage supply at the landscape level is through setting objectives in higher level plans. The guidelines in this appendix can be applied in TGBP units *and in other areas where studies or local knowledge indicate that management of grizzly bear habitat is necessary to meet forest management objectives.*

These guidelines were developed to resolve the conflict between traditional silviculture practices and the maintenance of landscape-level grizzly bear forage supply after logging in the coastal western hemlock (CWH) biogeoclimatic zone. Draft guidelines are being developed which will expand recommendations to the interior cedar hemlock (ICH) and engelmann spruce-subalpine fir (ESSF) zones. Studies show that there will be a forage deficit for the majority of the rotation on specific site associations in these zones where standard regional stocking targets are met and free growing stands are not spaced. Forage supply is limited during the stand establishment stage when broadcast vegetation management treatments are employed. Later in the rotation, forage is suppressed by the closed canopies that develop as successful plantations mature into later seral stages.

There may be grizzly bear population consequences of practicing traditional silviculture on these specific site associations in the CWH. Specifically, the consequences depend on the amount, distribution, age, and attributes of the recently harvested areas and young forests, and the availability of alternative forage outside the THLB. Fire suppression has also influenced the amount, productivity, and distribution of grizzly bear foraging habitat. These guidelines may help offset the consequences of the reduction in number of fire-originated stands, stands that have been traditionally utilized by grizzly bears, but no longer supply adequate forage.

The goal of these guidelines is to establish and maintain a commercially viable crop of trees, while managing for conditions conducive to the survival, growth, and productivity of grizzly bear forage throughout the rotation of the stand.

The guidelines are applied in a defined geographical area corresponding to the occupied range of the grizzly bears overlapping the CWH zone. Only specific forest ecosystems are affected: moist, very moist, wet, and floodplain site associations with high forage potential. These guidelines are applied as part of the regular planning processes. Site-specific decisions regarding implementation are made in the context of habitat supply in the vicinity. That is, stand-level prescriptions include careful consideration of the current and future habitat values from a landscape unit perspective. Consideration should be based on the amount of habitat outside the THLB and the harvest schedule within the THLB.

These guidelines can be implemented under the Forest Practices Code through regular consultation or referral of forest development plans (wildlife habitat issues and measures to protect), silviculture prescriptions, or stand management prescriptions. During the approval process, district managers will consider whether the application of these guidelines meets the test of adequately managing and conserving grizzly bears and their habitat (Section 41 FPC Act). At other stages in the planning process, these guidelines may be approved as one of the strategies to meet the objectives of a higher level plan.

Regardless of the mechanism for implementation, these guidelines are designed to be consistent with other integrated management guidelines, and are meant to supplement rather than replace other available planning tools. Site preparation, planting, vegetation management, backlog reforestation, spacing, and pruning activities may be affected.

These guidelines do *not* influence the decision to defer or exclude a particular stand from harvest.

The uncertainty level regarding the most economic and effective silviculture techniques and the need for site specific-flexibility are both high. As a result, these guidelines should be applied using the concept of adaptive management. Proposed treatments should include a mix of various operational practices and monitoring of treatment costs, forage response, and crop tree survival, growth and yield. Long-term and short-term monitoring of treatment effects will directly influence revisions of these guidelines as part of the adaptive management process. Three levels of trials are proposed for guideline application: formal, informal, and monitoring trials, which are chosen according to geographical location, site conditions, objectives, and available resources.

These guidelines focus on controlling stand density and canopy closure from planting through spacing and pruning. A clustered distribution of fewer crop trees/ha is recommended, rather than management for evenly spaced stems.

Stand density is controlled by manipulating four variables: number of trees per cluster, total number of clusters per hectare, inter-tree distance within the clusters, and distance between the clusters. (See Figure A11-1.) Two patterns are suggested: standard or uniform cluster, and dispersed or non-uniform cluster (see Figure A11-2.)

The guidelines preclude broadcast vegetation management treatments, and promote measures designed to increase crop value to offset the potential economic effects of a reduction in volume as a result of managing for lower stand density.

These guidelines have evolved from an original set of guidelines approved in 1992 for application in the CWH zone. This document replaces the *Interim Guidelines for Integrating Grizzly Bear Habitat and Silviculture in Coastal British Columbia*. Adaptive management trials, underway since 1993 in the CWH zone, support expanded application of a similar approach to the ICH and ESSF zones, in addition to continued application in the CWH. Future revisions to these guidelines will include recommendations for these interior zones.

Where the guidelines apply

Geographical area

Generally, these guidelines apply to all occupied grizzly bear habitat in the CWH zone in British Columbia. Special requests to implement the guidelines in areas not currently identified as occupied by resident adult females may be made by the Ministry of Environment, Lands and Parks (MELP) if new information becomes available about grizzly bear distribution. Such requests will only be made where the corresponding economic effects on timber supply can be demonstrated as insignificant, and there is potential for increased product value.

Application of these guidelines may also be requested in watersheds where grizzly bears have been extirpated, and a restoration effort to assist with population recovery has been initiated. The guidelines do not apply to townsites, mines, agricultural areas, high use recreation areas, or the immediate vicinity around them.

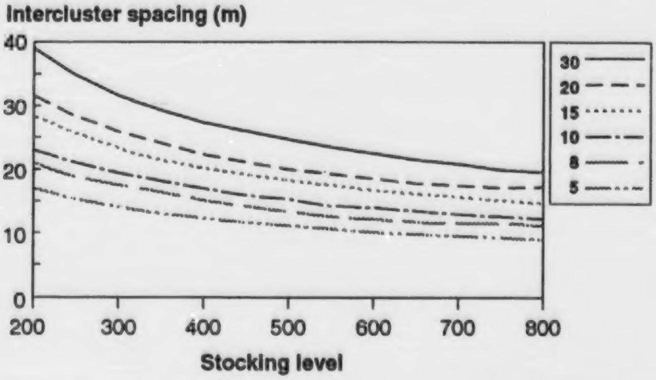

Figure A11-1. Inter-cluster distance by stocking level (with different cluster sizes).

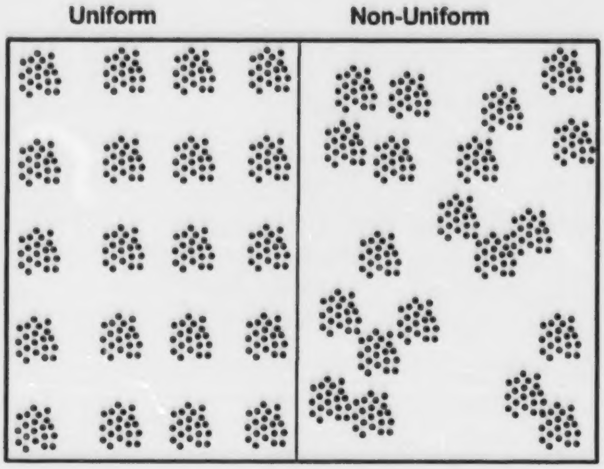

Figure A11-2. A comparison between uniform and non-uniform cluster distribution.

Ecological scope

These guidelines apply to medium to very rich nutrient regimes: fresh, moist, very moist, wet and floodplain site units in the CWH zone.

In the CWH, guideline application is restricted to variants of the very wet hypermaritime (CWHvh), wet maritime (wm), very wet maritime (CWHvm), dry maritime (CWHdm), dry submaritime (CWHds), moist submaritime (ms), and wet submaritime (CWHws) subzones. Table A11-1 lists site associations in the CWH covered by the guidelines.

Table A11-1. Grizzly bear habitat management – Ecosystems and site associations recommended for modified standards (after Banner *et al.*, 1993 and Green *et al.* 1994)

For medium to very rich soil nutrient regimes only

	Soil moisture regime	CWHvh (outer, inner)	CWHwm	CWHvm (submontane, montane)	CWHdm	CWHds (southern, central)	CWHms (southern, central)	CWHws (submontane, montane)
	Fresh	N/A	03 SsHw – Oak fern	05 BaCw – Foamflower	N/A	N/A	N/A	
	Moist	06 CwSs – Foamflower	04 SsHw – Devil's club	07 BaCw – Salmonberry[a] 08 BaSs – Devil's club[b]	07 Cw – Foamflower	07 Cw – Devil's club	06 BaCw – Devil's club	
	Very moist	07 CwSs – Devil's club						
	Wet	13 CwSs – Skunk cabbage	09 Ss – Skunk cabbage	CwSs – Skunk cabbage[c]				
FPL[d]	**high bench**	08 Ss – Lily-of-the-valley	Ss – Salmonberry[c]					
	medium bench	09 Ss – Trisetum	Ac – Red-osier dogwood[c]					
	low bench	10 Dr – Lily-of-the-valley	Ac – Willow[c]					

[a] In the Vancouver Forest Region CWHvm only.

[b] In the northern portion of the Vancouver Forest Region CWHvm and the Prince Rupert Forest Region CWHvm.

[c] Site series numbers vary by subzone.

[d] FPL = floodplain.

How the guidelines are applied

These guidelines are applied through the existing integrated management planning process by including specific provisions in sub-regional, landscape, and stand-level plans and prescriptions. Different provisions apply at the stand level for: 1) new SPs; 2) modifying existing SPs through amendments; and 3) Stand management prescriptions (SMPs). Details are provided below.

Application of the guidelines should be coordinated across landscape units, to obtain the maximum benefit of the adaptive management process. Every site where the guidelines are to be applied should be categorized by site heterogeneity, existing stocking, ease of access, and other factors. Formal, informal, or monitoring trials should be established to match the nature of the site with the rigour of the type of trial. Each trial type has a unique set of criteria for layout, treatment and monitoring as described in the original project working plan (see Reading list: McLennan and Johnson, 1993). Managers should consider the most appropriate approach for each situation, balancing operational considerations against the need to collect crop tree and forage response data.

Successful application of these guidelines is reliant upon six variables (Johnson and McLennan, 2000). These are:

1. Administrative support – where personnel are stable and well-established documentation exists.
2. Treatment size – the minimum should be greater than five hectares.
3. Site history – where fill-in planting was the first treatment to meet the forage objectives and seedling survival surpassed expectations, spacing may be required to offset the resulting high stocking levels.
4. Implementation support – involvement of MELP personnel is critical.
5. Species selection – Sitka spruce may have the best survival in brush conditions; where leader weevil problems exist, mixing species is good insurance.
6. Brush hazard – the best results occur where the brush hazard is moderate rather than high. Acceptable results occur on high brush hazard sites.

Sub-regional scale

Timber Supply Area (TSA) Plans

Land and Resource Management Plans (LRMPs)

Tree Farm License (TFL) Management and Working Plans

Implementation of these guidelines can be through their formal adoption in the appropriate sub-regional or higher level plan. Specific objectives and strategies should be inserted in these documents to enable guideline application where appropriate. Inclusion of such clauses at this planning level triggers modification of the standard regional stocking targets and free growing requirements at lower levels of planning, in order to meet specific integrated management objectives (e.g., grizzly bear forage supply).

Landscape scale

Local Resource Use Plans (LRUPs)

Landscape Unit Plans (LUPs)

Total Resource Plans

Long-term Forest Development Plans (FDPs)

Five-year Forest Development Plans

Integrated management in coastal British Columbia will benefit from landscape-level, long-term development plans that include designated areas for the protection of riparian values, wildlife habitat, old-growth forests, and linkage corridors. However, these plans should also contain general provisions for the protection, maintenance, or enhancement of biodiversity and wildlife habitat values in areas scheduled for harvesting or silviculture treatment. Where both timber and wildlife habitat values are high, specific measures such as those specified in these guidelines are required to supplement the general provisions.

Harvesting and roading are traditionally emphasized at this level of planning. However, landscape-level and long-term plans for silviculture should be developed concurrently, especially for watersheds with extensive historic harvesting. These guidelines can be used to restore grizzly bear habitat value in landscapes with historically high rates of cut on the lower slopes and valley bottoms. Backlog or older not satisfactorily restocked (NSR) areas may be good candidates for guideline application where lower stocking levels are already on site. Established stands nearing canopy closure may also be good candidates because they can be spaced to enhance forage production, as long as the resulting debris will not hinder wildlife movement or forage response.

Examine each watershed for the applicability of these guidelines.

The guidelines should be applied on sites within the development area where there is, or may be, a forage shortfall as a result of traditional silviculture treatments.

Guideline application is especially critical in parts of the landscape where there are no alternative foraging areas in the vicinity – either within or outside of the THLB.

Decisions regarding guideline implementation should be part of the regular development planning process. Application will be most effective when linked to long-term silviculture and development plans (i.e., 20 year plans). However, the guidelines *can* be applied during the forest development planning process under "wildlife issues: measures to protect." Special attention must be given to habitat supply over a longer term and broader area than contained in the forest development plan, and at a scale appropriate for grizzly bears – the entire landscape unit and the balance of forage values on and off the THLB.

These guidelines should not be viewed as a mitigative measure that can influence the decision to exclude particular stands within a landscape. In many cases, the only way to protect the value of an area with high biodiversity and habitat values will be exclusion (e.g., as old-growth management areas [OGMAs] or WHAs for identified wildlife). These guidelines are only considered a tool for integrating grizzly bear habitat concerns with timber and other non-timber objectives *after* the value of the habitat at the landscape level has been weighed, and the decision to harvest or exclude has been made.

Stand scale

New silviculture prescriptions (SPs)

Revised regional establishment to free growing stocking standards for target, minimum, and maximum densities (see Table A11-2) were developed for this guidebook.

Table A11-2. Recommended establishment to free growing stocking standards for the CWH biogeoclimatic zone – grizzly bear habitat management objectives

		Free growing stocking standards[b] (stems/ha)		
Subzone variant	**Site association[a]**	**Target**	**Minimum**	**Maximum[c]**
vh1 and vh2	CwSs – Foamflower	600	400	660
wm	SsHw – Devil's club	600	400	660
vh1 and vh2	CwSs – Devil's club	600	400	660
vm1 and vm2	BaCw – Salmonberry BaSs – Devil's club	600	400	660
dm	Cw – Lady fern	600	400	660
ds1 and ds2	Cw – Devil's club	600	400	660
ms1 and ms2 ws1 and ws2	BaCw – Devil's club	600	400	660
vh1 and vh2 vm1 and vm2 dm ds1 and ds2 ms1 and ms2 ws1 and ws2	CwSs – Skunk cabbage	400	200	440
wm	Ss – Skunk cabbage	400	200	440
vh1 and vh2	Ss – Lily-of-the-valley Ss – Trisetum	500	200	550
wm vm1 and vm2 dm ds1 and ds2 ms1 and ms2 ws1 and ws2	Ss – Salmonberry Ac – Red-osier dogwood	500	200	550

[a] Stocking levels for low bench floodplain site associations are not listed; site-specific prescriptions should be developed that account for the naturally low density of microsites appropriate for crop tree growth and high shrub cover.

[b] The "well spaced" clause does not apply to forage gaps when stems are clustered as part of the silvicultural prescription. Crop tree size vs. competing brush standards are unchanged from existing regional guidelines. When determining the number of crop trees, minimum inter-tree distances, as stated in the silviculture prescription, still apply to trees within the cluster.

[c] If stand exceeds maximum density set in the prescription at free growing, these guidelines recommend spacing back to this stocking level.

Stocking standards

As mentioned, reduced stocking levels indicated in Table A11-2 should be applied where there is a concern about the continuous supply of grizzly bear forage.

The list of acceptable tree species for these guidelines are as recommended in the field guides for the Vancouver and Prince Rupert forest regions. For instance, where appropriate, floodplain ecosystems can be managed for black cottonwood or red alder. At present it is unclear how managed black cottonwood forests affect forage potential. However, initial indications are that lower densities have higher forage potential, and adjustments to spacing of crop trees may be requested. MELP may also request application of these guidelines where red alder stands are to be converted to conifer stands.

Forage objectives

Where forage production is to be maintained or enhanced, the species listed in Table A11-3 are considered acceptable "grizzly bear forage." *Prescriptions should attempt to manage for a stand structure with gaps similar to those of mature or old forest structural stages.*

The stand should be examined to locate existing openings or gaps where the preferred grizzly bear forage species are abundant. These areas should be identified on maps, measured, and used as a template to determine the location and size of gaps that should be created and maintained in the managed stand. If mapping is not possible, the gap configuration should be described adequately to allow for interpretation when designing the managed stand.

Inter-tree distance and trees per cluster

The recommended range for inter-tree distance within clusters is 1 m at the lower limit and 2 m at the upper limit. Closer spacing is recommended for smaller clusters, where competition is lower. Wider spacing is recommended for larger clusters which provides more growing space. Tolerance of 20% of the desired inter-tree distance should be allowed for selection of optimum microsites within the cluster and to avoid obstacles.

The inter-tree distance between trees at planting should account for anticipated mortality. If the mortality is limited to small, identifiable patches within the site, inter-tree spacing can be adjusted to maintain the desired distribution of clusters and required density.

The number of trees per cluster required to meet the recommended density should be determined according to the conditions on site. Factors to consider include the size of available microsites and their distribution, species selection, anticipated post-free growing mortality, and the ability of the trees to self prune within the cluster. The target number of trees per cluster should be in the range of 10 to 30 seedlings. Larger numbers of trees per cluster result in larger forage producing gaps. However, no more than 30 trees should be clustered together.

Table A11-3. Coastal grizzly bear forage species (listed in descending order of preference)

Devil's club	*Oplopanax horridus*
Red elderberry	*Sambucus racemosa*
Currants and gooseberries	*Ribes* spp.
Skunk cabbage	*Lysichitum americanum*
Small-flowered bulrush	*Scirpus microcarpus*
Sitka sedge	*Carex sitchensis*
Cow-parsnip	*Heracleum spondylium*
Mountain sweet-cicely	*Osmorhiza chilensis*
Kneeling angelica	*Angelica genuflexa*
Highbush-cranberry	*Viburnum edule*
Black twinberry	*Lonicera involucrata*
Salmonberry	*Rubus spectabilis*
Red raspberry	*Rubus idaeus*
Black raspberry	*Rubus leucodermis*
Trailing blackberry	*Rubus ursinus*
Blue and huckleberries	*Vaccinium* spp.
Red-osier dogwood	*Cornus sericea*
Lady-fern	*Athyrium filix-femina*
Horsetails	*Equisetum* spp.
Hedge nettles	*Stachys* spp.
Water parsley	*Oenanthe sarmentosa*
Hemlock parsley	*Conioselinum pacificum*
Thimbleberry	*Rubus parviflorus*

As desired cluster size increases, mixed species should be considered. Shade-tolerant species (e.g., western hemlock) or species subject to epicormic branching (e.g., Sitka spruce) should be planted in the centre of the cluster and species less shade-tolerant should be planted around the cluster perimeter.

The target number of trees per cluster should reflect the desired stocking levels at free growing and anticipated stocking at rotation, considering any stand tending activities that may be undertaken.

Cluster distribution

When cluster planting is prescribed, silviculture prescriptions should specify target trees per cluster and target clusters per hectare, in addition to the target stocking standard (see Tables A11-2, A11-4).

Table A11-4. Grizzly bear habitat – recommended clusters per hectare and inter-cluster distances based on stocking and trees per cluster[a]

Stocking (trees/ha)	Clusters per hectare								Inter-cluster spacing (m)							
	Trees per cluster								Trees per cluster							
	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
200	25	29	33	40	50	67	100	200	21.5	20.1	18.6	17.0	15.2	13.2	10.7	7.6
250	31	36	42	50	63	83	125	250	19.2	18.0	16.6	15.2	13.6	11.8	9.6	6.8
300	38	43	50	60	75	100	150	300	17.5	16.4	15.2	13.9	12.4	10.7	8.8	6.2
350	44	50	58	70	88	117	175	350	16.2	15.2	14.1	12.8	11.5	9.9	8.1	5.7
400	50	57	67	80	100	133	200	400	15.2	14.2	13.2	12.0	10.7	9.3	7.6	5.4
450	56	64	75	90	113	150	225	450	14.3	13.4	12.4	11.3	10.1	8.8	7.2	5.1
500	63	71	83	100	125	167	250	500	13.6	12.7	11.8	10.7	9.6	8.3	6.8	4.8
550	69	79	92	110	138	183	275	550	13.0	12.1	11.2	10.2	9.2	7.9	6.5	4.6
600	75	86	100	120	150	200	300	600	12.4	11.6	10.7	9.8	8.8	7.6	6.2	4.4
650	81	93	108	130	163	217	325	650	11.9	11.2	10.3	9.4	8.4	7.3	6.0	4.2
700	88	100	117	140	175	233	350	700	11.5	10.7	9.9	9.1	8.1	7.0	5.7	4.1
750	94	107	125	150	188	250	375	750	11.1	10.4	9.6	8.8	7.8	6.8	5.5	3.9
800	100	114	133	160	200	267	400	800	10.7	10.1	9.3	8.5	7.6	6.6	5.4	3.8

[a] Clusters per hectare are calculated from planting targets for planting activities; from stocking targets for juvenile spacing activities.

Two methods have been developed to determine the prescribed number of clusters per hectare.

1. Final crop tree method

The final crop tree formula is the preferred method of determining the number of clusters. Managers must first determine the number of crop trees desired at rotation. Working backward from the density at final rotation, free growing targets and planting targets should be established based on appropriate mortality factors for the site. The following should be considered when deriving a mortality factor: species selection (e.g., shade-tolerant species show less mortality), availability of suitable microsites (e.g., moisture and nutrient requirements, likelihood of flood events), vegetative competition, and anticipated mortality due to stock handling. Dividing the planting target stocking by trees per cluster will result in the required number of clusters per hectare.

$$\#\text{ clusters/ha} = \frac{\text{planting target}}{\#\text{ trees per cluster}}$$

2. Target stocking method

Managers wishing to use the target stocking method should first consult Table A11-2 to determine the free growing target stocking recommended for the site series. Next they should establish a mortality factor based on the site series and conditions, as in the final crop tree method, to derive the planting target. Dividing the planting target stocking by trees per cluster will result in the required number of clusters per hectare.

Table A11-4 and Figure A11-1 can be consulted to help verify the calculated figure.

$$\text{\# clusters/ha} = \frac{\text{planting target}}{\text{\# trees per cluster}}$$

Spacing between clusters should be adjusted to reflect site conditions and microsite location. Uniform distribution of clusters over the block is appropriate where site conditions are relatively uniform. However, clusters should be located on appropriate planting sites, taking advantage of natural site features such as elevated hummocks or stumps.

Inter-cluster spacing is measured from the centre of one cluster to the centre of the adjacent ones on a square grid. Prescribed inter-cluster spacing can be determined using Table A11-4 and Figure A11-1. However, where sites are undulating, clusters should be located on appropriate planting sites to take advantage of natural features such as elevated hummocks or stumps. Inter-cluster distances should be varied in order to optimize microsite selection.

Inter-cluster spacing is recommended to be a minimum of 80% and a maximum of 120% of that required to achieve the desired planting target. This range should result in achieving the overall desired stocking density, within acceptable statistics limits, when a stocking survey is applied across the area.

"Dispersed or non-uniform cluster" uses a mix of cluster densities across the block, and is appropriate for some blocks where microsites suitable for clusters (e.g., elevated hummocks) are not evenly distributed. See Figure A11-2 for a graphical comparison between uniform and non-uniform cluster distribution.

For dispersed cluster planting, the minimum inter-tree distance within a cluster is 1 m on suitable microsites. The number of suitable clusters per hectare should be estimated from a reliable survey that covers the entire area. The minimum/maximum inter-cluster distances may then vary substantially, as long as the overall target density is met.

Control of competing vegetation

These guidelines preclude broadcast vegetation management treatments.

Broadcast vegetation management using either mechanical or chemical control methods should not be prescribed as site preparation. Sites should only be prepared for regeneration using *selective* vegetation management treatments. For example, elevated microsites with fewer competing shrubs could be treated for planting using a cluster/gap configuration if treatments are focused on the elevated microsites (i.e., where planting will occur).

After seedling establishment, vegetation management activities are restricted to the area immediately surrounding clusters. Backpack chemical applications or motor-manual brushing is the preferred form of treatment. Treatments must be designed to directly reduce competition for the crop trees, and care should be taken to avoid treating grizzly bear forage species which are not direct competitors. No limits are placed on the number of treatments that need to be conducted to ensure crop tree survival and growth, because the selective nature of treatments avoids much of the forage.

Maximum density

Under regulation and chief forester direction, a Ministry of Forests regional manager can set maximum density thresholds below the 10 000 coniferous trees/ha default, to accommodate a specific resource management objective (e.g., grizzly bear forage supply). Table A11-2 recommends the maximum density limit by site series.

Where stands are expected to surpass this density after harvest, a survey should be conducted to determine the feasibility of spacing to meet free growing standards for clustered stands. If the stand is highly clustered with trees of varied heights, and forage gaps are well distributed, the maximum density limit could be increased to 1500, 2000, and 2500 trees/ha, from 440, 550, and 660 trees/ha respectively. The ultimate objective of whether the stand density maintains grizzly bear forage is the determining factor.

Spacing to specifically meet forage supply objectives should encourage the formation/maintenance of gaps and openings in the stand. Existing gaps should be enhanced or spaced around to provide an even distribution of gaps across the treatment area where possible. Spacing should occur both *in the clusters* to maintain the target cluster size, and *between the clusters* to eliminate bridging of the gaps by natural regeneration.

Post-spacing density should be between the target and minimum specified in the silviculture prescription, as recommended in Table A11-2.

The competing brush standards to meet free growing are unchanged from existing standards.

If the maximum density threshold is exceeded, juvenile spacing is required at least two years before the latest free growing date to ensure survival of forage species.

Pruning

When stocking levels specified in the SP are at least 30% lower than regular minimum stocking, and habitat objectives are specified in an operational plan, pruning must be conducted before the end of the free growing period (see *Silviculture Practices Regulation*, and ensure the district manager is in agreement with the necessity of pruning). First- and second-lift pruning would be prescribed to meet timber and forage production objectives on CwSs-Skunk cabbage and Ss-Skunk cabbage site associations.

Pruning may be used along with or instead of spacing to meet density requirements for basic or incremental silviculture. First- and second-lift pruning may have a similar effect on forage production as reducing the stocking level. However, the most effective means of ensuring forage supply is through density control. Pruning can also meet timber objectives by improving the final crop tree value.

Pruning is most appropriate for trees on the edge of clusters because the light regime in the cluster centre will likely cause trees to self prune. Pruning is also appropriate if the guidelines are applied retrospectively in established open grown stands. All or only a portion of the trees may be prescribed for pruning, depending on the site-specific conditions, and the silvics of the trees.

Pruning should be considered under these guidelines primarily on the CwSs-Skunk cabbage and Ss-Skunk cabbage site associations where 400 stems/ha is the target stocking level and 200 stems/ha is the acceptable minimum. Under these conditions, the free growing period on these sites should be extended to 15 to 20 years.

The debris generated by spacing and pruning may limit forage species establishment, growth, and berry production. Wherever possible, forage gaps should be kept free of branches and excess trees. Debris should be concentrated in conifer clusters.

Surveys/Inspections

Initial joint site visits by MELP, MoF, and the licensee are highly recommended. During these inspections, silviculture prescription recommendations can be developed that reflect the best professional opinions.

Quantification of existing variables can be decided, survey parameters can be discussed, and a monitoring schedule determined.

All projects to date have identified and marked cluster centres prior to treatment. Post-treatment surveys then focus on ensuring that the inter-tree distances and number of trees per cluster fall within acceptable statistical limits.

A standard systematic random sample design can be used for the post-treatment survey. Transects should follow the pattern of cluster distribution in order to minimize the length of transect required, however, the entire treatment area should be covered. A minimum of five plots or clusters per stratum is recommended for sampling. This minimum may have to be increased where a dispersed cluster pattern has been used. Units can be stratified by site series, density, cluster pattern, and other factors. Sampling of tree heights and other related measurements can be the same as for standard surveys of non-clustered treatments. Again, cluster centres should be permanently marked (with aluminium or electrical conduit) to facilitate treatment follow-up.

If cluster centres are not marked prior to treatment, the post-treatment surveys need to estimate total density by sampling the number of clusters per hectare.

Modifying existing SPs through amendments

Amendments to existing SPs to adopt the stocking levels specified in Table A11-2 should be considered if:

1. Concern about the long-term supply of grizzly bear forage is expressed by MELP.
2. Prescribed treatment units fall within the ecological scope of these guidelines.
3. The amendment is compatible with the intent of the original SP. For example, "...establishing a free growing stand of healthy, commercially viable crop trees."
4. The free growing period is being extended to 15–20 years on skunk cabbage sites.

Although amendments related to changes in specific activities are not necessary for SPs developed under the results-based Code, managers are encouraged to discuss possible changes with the local MELP habitat representative. Changes should be considered with landscape unit objectives in mind. Often, changes to existing SPs need to be considered in the context of developing current SPs in the same general vicinity.

New stand management prescriptions (SMPs) or modifying existing SMPs

Similar provisions as discussed above apply where stands are being considered for treatment post free growing. In some cases, applying these guidelines on blocks scheduled for stand management might reduce the need to apply them on current harvesting SPs in the vicinity. In all cases, the ecological conditions across the landscape should drive the decisions whether to conduct silviculture treatments to maintain or enhance habitat.

Specific upper densities are required to maintain the gaps created by cluster planting. When density exceeds the maximums indicated in Table A11-2, juvenile spacing should be conducted.

For stands well beyond free growing age, the densities and corresponding inter-tree spacing recommended in Tables A11-2 and A11-4 may have to be revised to reflect the conditions of the older stand. Little forage response is expected if canopies have been closed for more than 10 years. Therefore, application of these guidelines should occur on stands with relatively open canopies or patchy conifer distribution (see Greenough and Kurz (1996)). Local knowledge and results from adaptive management trials should be considered when prescribing appropriate densities.

(See *Guidelines for Developing Stand Density Management Regimes* and the *Stand Management Prescription Guidebook* for more details).

Backlog silviculture

Achieving the desired clustering of crop trees on backlog NSR sites may be problematic due to the number and distribution of existing seedlings. Wherever possible, a clumped distribution of crop trees at standards recommended in these guidelines is desired, *rather than management for evenly spaced stems*. If a cluster/gap configuration doesn't exist even with reduced stocking targets, spacing and/or pruning may be required to maintain forage potential and timber values at guideline stocking densities.

Broadcast vegetation management on backlog sites may be acceptable if the economics and/or logistics of releasing the existing crop trees are such that selective treatment is unrealistic (e.g., a continuous cover of salmonberry exists over the seedlings). However, if existing crop trees can be released selectively, broadcast methods should be excluded.

Monitoring

An adaptive management approach includes monitoring for the effectiveness of the treatment. General monitoring procedures are described in adaptive management literature (Taylor *et al.*, 1997; Sit and Taylor, 1998); *Procedures for habitat monitoring* (1996); and *Habitat/Ecosystem objectives and monitoring procedures for incremental and backlog silviculture treatments* (1998). Specific methods were used in Johnson and McLennan (2000) and Johnson (1995). In any case, the limited number of applications of these guidelines justifies surveys in addition to those required for regular silviculture treatments. Several funding sources may be available to cover the additional costs, in the interest of extending the results and conclusions to other applications. Where funding is limited, walk-through surveys can provide useful information at minimal cost.

Monitoring plots consist of sampling clusters or conifer plots, and inter-cluster or forage plots. Conifer plots are selected randomly, and forage plots are located systematically around the selected conifer cluster. Historically, cost and access considerations have limited the sampling intensity to 90 conifer plots and four forage plots per treatment unit. See Appendix 2 in Johnson (1995) for more details (included as an addendum to these guidelines).

Expansion of guidelines

Guidelines for the ICH and ESSF zones are being developed. ICH guideline application will be restricted to variants of the dry cool (ICHdk), dry warm (ICHdw), moist cold (ICHmc), moist cool (ICHmk), moist mild (ICHmm), moist warm (ICHmw), very wet cold (ICHvc), very wet cool (ICHvk), wet cold (ICHwc), and wet cool (ICHwk) subzones.

In the ESSF, guideline application will be restricted to variants of the dry cold (ESSFdc), dry cool (ESSFdk), dry very cold (ESSFdv), moist cold (ESSFmc), moist cool (ESSFmk), moist mild (ESSFmm), moist very cold (ESSFmv), moist wet (ESSFmw), very wet cold (ESSFvc), wet cold (ESSFwc), wet cool (ESSFwk), wet mild (ESSFwm), and wet very cold (ESSFwv) subzones.

Managers who may want to apply these guidelines to interior sites are encouraged to contact the MELP. Opportunities for establishing trials may be available.

ADDENDUM

METHODS OF FORAGE SAMPLING FOR GRIZZLY FORAGE TRIALS – JUNE 1995 (from *Progress Report – Activities Completed for the Grizzly Forage Assessment Project, Fiscal 1995, Appendix 2*; Tom Johnson; prepared for the Ministry of Environment, Lands and Parks, Wildlife Branch, Victoria, BC)

Plot Establishment

Monitoring plots will consist of cluster, conifer plots; and inter-cluster, forage plots. Conifer clusters on the borders between treatment units are not considered acceptable candidates because conifer vigour and forage response will be affected by adjacent treatments. Conifer plots will be selected randomly from internal clusters and forage plots will be located systematically around the selected grid point of the conifer cluster. In order to centre the forage plots within the gap, plots will be located on the mid-point of the diagonal between conifer clusters.

Present estimates of variability indicate that 90 conifers and 4 forage plots will be sampled per treatment unit. Where plots fall in areas not representative of the forage community the plot will be dropped and additional conifer clusters will be randomly selected as centres for substitute forage plots. Unsuitable areas include back channels, untreated areas, or brushed inter-cluster areas.

The conifer plots will not have a set radius as the intent of monitoring is to sample all trees within the planted cluster, and planting obstacles result in asymmetrical cluster shapes. When plots are established, all seedlings within the plot will be marked with a numbered pigtail wire and recorded. The five leading species of plants will be described for each plot. Once conifer clusters are declared free growing, more detailed vegetative data will be collected from within the conifer cluster. The conifer plots will all be permanently staked with 1.5 m metal posts, and be clearly labelled for future reference. Forage plots will be 3.99 m in diameter and referenced to these permanent posts.

Conifer Plots

In the conifer clusters the measurements will be:

- Number of conifers
- Species
- Total height
- Leader height on determinate species
- Planted or volunteer tree.

Each tree will be marked with a pigtail stake and numbered with metal tags to facilitate long term monitoring. Volunteer trees will be counted and measured if they are within the boundary of the planted cluster.

A brief qualitative description at each conifer plot will be done covering:

- Treatment or condition at time of monitoring
- Cover of the 5 dominant species.

A full plot description will not be done at this stage as there are too many other factors which would influence the data. These outside influences include manual brushing and brush mats. Full plot [measurements] should be done at a later date, once the trees in the clusters are free growing and start influencing the shrub and herb layers.

In control treatment units, the forage plots and the conifer plots will have the same centre. The forage plots will be 3.99 m in diameter and the conifer plots will be 5.64 m in diameter. This is done to minimize the number of conifer plots needed to reach the target number of measured trees.

Forage Plots

Percent Cover

In forage plots, percent cover will be measured for all shrubs and herbs. All forage species will be identified to species level. Non-forage species will be identified to species where possible and to the family level as a minimum.

Cover for plants will be recorded by height class. The height class which cover for a particular plant is tallied in is determined by the height class of the top of the plant. Species cover can be recorded in two or more height classes if the tops of plants of one species occur in more than one height class. A single plant cover will be estimated by quadrant then totalled and divided by 4 for an average figure.

If any part of a plant falls within a plot, that portion within the plot will be recorded as cover. The germination point will not determine if cover is tallied in the plot.

Height Class

Proposed height classes for plants:

- Shrub/conifer – B1 – Tall shrub/conifer 5-10 m
  – B2 – Medium shrub/conifer 1–5 m
  – B3 – Low shrub < 1 m; conifers 15 cm – 1 m
- Herb – C1 – Tall herb >50 cm
  – C2 – Low herb <50 cm

- Moss – Conifers <15 cm
- Conifers >10 m will be tallied in the A layer

Vegetation Description

For plant species identified as Grizzly Bear forage, the following will be recorded:

- Vigour
- Distribution
- Vegetative phenology
- Generative phenology
- Percentage stems bearing fruit/flowers
- Average abundance of fruit/flowers on stems.

The methods and coding for these measurements will be as described in Field Manual for Describing Terrestrial Ecosystems: Chapter Three – Vegetation (Ministry of Environment, Lands and Parks/Ministry of Forests, 1998).